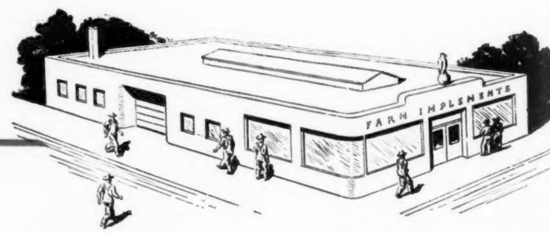
AGRICULTURAL ENGINEERING

NOVEMBER · 1945

THE JOURNAL OF THE AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS

Contour Farming



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AGRICULTURAL ENGINEERING

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CONTENTS FOR NOVEMBER, 1945

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EDITORIAL

Farm Building Construction*

By J. Dewey Long
President, A.S.A.E.

ALL indications point to very large expenditures during the next few years in farm construction. Including both dwellings and the production structures which the farmer uses in his daily work, and considering both repair and new construction, all authorities agree that the total expenditures will range between one and two million dollars a year for each of the next ten years, providing no unforeseen economic reverses occur.

According to the U. S. Census of 1940, farm building values now are about the same as they were in 1910. Expenditures in this field reached their peak at $950 million in 1919; the highest subsequent annual expenditure in 1941 was about three-fourths of this maximum. Meanwhile, during this past quarter-century, depreciation and obsolescence have been working overtime, and the development of new farm lands and of new farm families have made the need for farm repairs and new construction acute.

Considering this accumulated need, and the fact that the farmer's balance sheet is currently the best it has ever been, the USDA Bureau of Agricultural Economics estimates that agriculture is prepared to spend in the neighborhood of a billion dollars a year for construction purposes.

Former Secretary of Agriculture Claude R. Wickard, in appearing recently before the Taft Committee, testified that "about two-thirds of the nation's farm families are ill-housed. Nearly half of the inadequate houses are beyond repair. * * * On the basis of 1944 estimates it appears that about two million (of 6½ million farm homes) need major improvements and about the same number should be entirely replaced."

Dwellings are not the only farm interest for the construction industry. Farmers use production structures as an essential part of their farm operating equipment. These also are in a deplorable condition due to the ravages of time and obsolescence.

Representatives of the Farm Structures Institute appearing before the farm structures legislative committee of the Association of Land Grant Colleges and Universities within the past year stressed this fact that farm buildings are tools of production. New construction has not offset depreciation in the years following the high farm income period of World War I. Furthermore, changes in farm practices have outmoded many original designs and arrangements and the recent war years have made farmers conscious as never before of the need for labor saving around the farmstead where from 30 to 70 per cent of their work is performed.

According to the figures compiled by the FSI, "a conservative replacement estimate of $5,000 per farm for all farm buildings would mean a total national outlay of more than 30 billion dollars. (In many states the investment in farm buildings represents a greater cost outlay than the value of the land). At present labor rates and material costs, it would require at least $20 billion during the next ten years to put these on an efficient operating basis. Two billion dollars may seem a high annual sum for this purpose. Yet an average of $308 per farm per year is a small outlay when it is realized that 1,004 FSA clients in the northeast states (during 1938-41) spent an average of $1,180.45 for only absolutely necessary farm building repair. * * * It is obvious that we need to put into operation a program by which farm buildings can be made to contribute to better farming and better farm living. This program would consist of the development, through research, of dependable and accurate information on the proper functions of farm structures as aids to economical production, improved and economical construction practices, and the dissemination of that information to all interested parties."

The agricultural engineering profession, with a primary interest in this field, recognizes both the implications for national economic betterment and the problems which are involved. Not the least of the latter is the education of the farm operator in the proper selection and construction of suitable housing and utility structures. Furthermore, some caution must be exerted to prevent enthusiasts from overbuilding any particular farm beyond its economic ability to pay, although some proponents advance the theory that educating certain classes of farmers to a desire for more suitable dwellings and working equipment will be no little stimulus to their adoption of improved and more productive farming practices.

Considering all phases of the problem, and presuming that public monies are to be expended in the development of housing in all its ramifications, the American Society of Agricultural Engineers recommends to the Construction Industry Advisory Committee consideration of a four-point program through which such federal expenditures for farm construction may be expected to be most productive, as follows:

1 *Research.* The functional requirements for both dwellings and production structures suitable to modern farming must be ascertained, and accurate information secured on the suitability of new materials and new construction practices. The various state *(Continued on page 455)*

*A statement prepared for a nation-wide conference on building construction at Washington, D. C., November 1, 1945, sponsored by the Construction Industry Advisory Council, Chamber of Commerce of the U.S.A.

About Those Boomlets

FAR from spectacular, in a period when nothing less than dreams about atomic energy will stimulate a jaded public mind, is the paper by John W. Slosser which appears as the leading article in this issue. Yet we find it inspiring as an example of the everyday effort, indeed drudgery, of agricultural engineers to search out and solve wherever they may exist, sometimes not even recognized, the problems of an advancing agriculture.

The inadequacy of potato spray application had long persisted; it merely was aggravated by the topography of soil conservation structures. From the goading of that aggravation grew a new appraisal of the entire problem, and a new approach with such promise as seems destined for adoption on even the most flat and level fields. Perhaps this humble development hardly qualifies as another case of rational design, but at least it began with a survey of plant and pest biology.

Already apparent is the cooperation of the agricultural engineer with scientists in other phases of agriculture, a kind of cooperation possible only by engineers broadly familiar with the facts of farm life. Ahead lies the need for cooperation with industry, but to perfect the details of design for foolproof operation and economical manufacture, and to press the new boomlets into use through selling effort and service facilities.

AGRICULTURAL ENGINEERING

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An Improved Sprayer Boom for Potatoes and Other Row Crops

By John W. Slosser
MEMBER A.S.A.E.

FOR many years Bordeaux mixture has been an accepted material for the control of late blight in potatoes. This mixture, together with a stomach poison, usually in the form of calcium arsenate, has been the chief reliance of the potato grower for the control of disease and of chewing insects.

Unfortunately these insects prefer to work and lay their eggs on the under surfaces of the leaves of the plant. It also appears from observations that certain diseases are prone to gain initial foothold on the undersurfaces and on the lower leaves. These factors call for a reasonably complete leaf and plant-surface coverage of protective spray material for satisfactory control. The difficulty of obtaining a satisfactory coverage increases as the plants reach maturity or luxuriant foliation under optimum growing conditions.

Research studies in 1940 by the Soil Conservation Service in cooperation with the Maine Agricultural Experimental Station at Fort Fairfield and at Presque Isle, Maine, disclosed that with the conventional sprayer boom very little more than the upper surfaces of the leaf canopy was receiving an adequate spray coating. In these tests, normal operating pressures of 350 to 400 lb. were used. Increasing nozzle pressures to 500 lb and upwards tended to agitate the plants somewhat, and by so doing, a slightly increased coverage was obtained. The extent of coverage obtained by a a single spraying with the conventional boom, regardless of pressure and nozzles used, was considered far below that required for effective blight control.

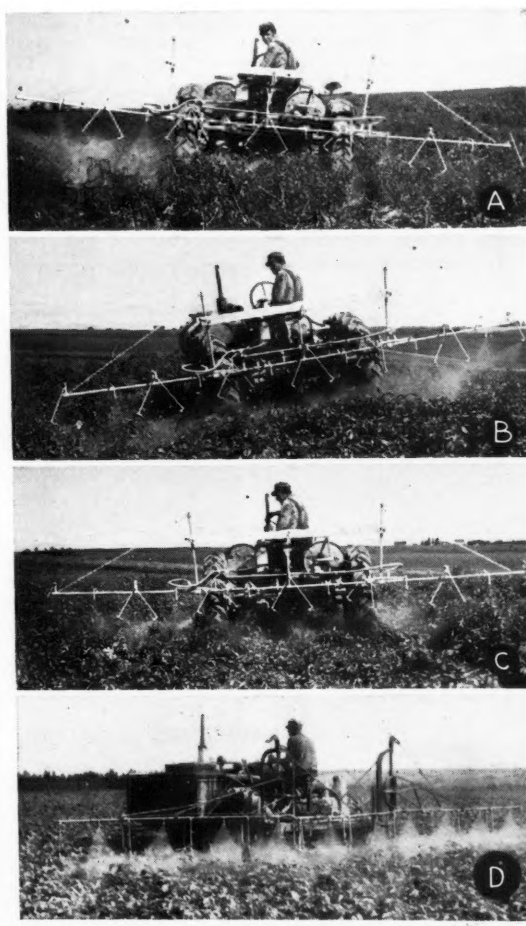

Fig. 1 These views illustrate disadvantages of the conventional sprayer boom. (A) View showing nozzle misplacement on a conventional boom, due to tractor operating on channel side of terrace ridge. Note that right end of boom is dragging in tops, whereare left end is far above plants. (B) Similar to A; tractor is operating astride terrace ridge. Note nozzle-to-plant variations. (C) Similar to A; tractor is operating in terrace channel, and both ends of boom are dragging in the potatoes. This condition when spraying produces a very ineffectual job. (D) Longer spray booms impose greater operational difficulties and involve mechanical complexity of construction for adjustments. This view is of a commercial unit in wide use in Aroostook County, Maine

A serious disadvantage of the conventional boom is the difficulty of maintaining reasonable plant-to-nozzle relationships (Fig. 1). Terraces, natural depressions and elevations exaggerate the boom movement, making it impossible to maintain uniform plant-to-nozzle distances without constant attention and adjustment. Many standard booms have no adjustment provided, being designed for strictly level work on smooth land.

In order to overcome these obvious shortcomings of the conventional spray boom, the following requirements were set up:

1 The sprayer boom should be so constructed that ground surface irregularities do not affect its operation.

2 Nozzle placement and distribution should be such that a maximum of the leaf surfaces of the plant will be exposed to the spray cones.

3 The amount of pressure and the nozzle type should be such that the individual spray particle travels with a minimum velocity. This assures that these particles do not bounce or run off the surface of the leaf or be deflected by a built-up air cushion.

4 The boom must be readily adjusted to compensate for plant growth during the season.

5 The boom must have a minimum of mechanical complexity.

During the period 1940-44, a number of booms of different type and arrangement were constructed on our research project and tested under varied conditions in potato fields. Figs. 2 and 3 show

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This paper was prepared expressly for AGRICULTURAL ENGINEERING. It reports research studies by the Soil Conservation Service, USDA, in cooperation with the Maine Agricultural Experiment Station.

JOHN W. SLOSSER is a project supervisor, Soil Conservation Service, U. S. Department of Agriculture.

Fig. 2 (Left) Static view of the original three-unit test model showing nozzle placement. Note vine agitator or spreader rods. In the later models the lower or secondary set was not used • Fig. (Right) A view of the original test model operating in young plants. Note that spray is concentrated in the plant-occupied area

one of the original attempts to meet these requirements. Test runs of the device in comparison with the conventional boom indicated that superior coverage and distribution was obtained with the individual-row boom. The additional advantage of a much lower operating spray pressure was also obtained. This represents less wear and consequent longer life for the spray pump and, at the same time, a reduced cost as low pressure fittings and hose are much more reasonable in price.

Fig. 4 shows the new boom attached to a tractor sprayer as used in later tests. The experimental sprayer shown is a five-row unit. Eeach drop or boomlet is mounted on a shaft allowing for free vertical movement of the lower end. The lower end of the boomlet is provided with a sliding shoe which in operation rests on the soil surface between the plant rows (Fig. 5). Thus surface irregularities or soil conservation structures do not affect the relative positioning of the spray nozzles with respect to the plants.

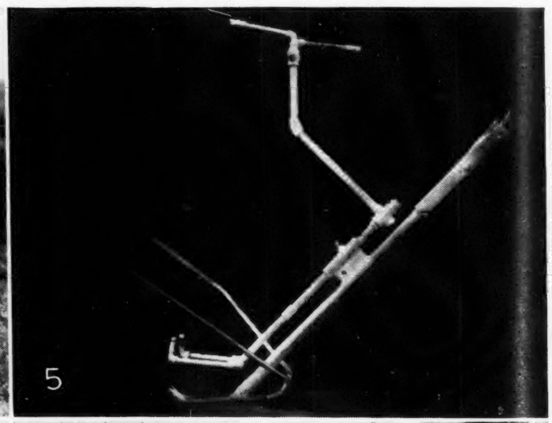

Fig. 4 Rear view of experimental five-unit sprayer boom in lowered or spraying position • Fig. 5 Side view of boomlet showing details of construction and provision for adjustment of nozzle assembly. Nozzles on this assembly are of the low-pressure tangential-whirl type, which produces a fine, soft spray • Fig. 6 View showing concentration of spray in plant area due to nozzle placement. This view shows a simpler and more effective upper nozzle assembly than that in Fig. 4 • Fig. 7 Detail view showing lift shaft, valve mechanism, and water connections on the experimental sprayer boom

Four conventional spray nozzles are used on each boomlet. Two of these are on the upper pipe assembly located in such a manner as to spray the tops and sides of the row. The remaining pair of nozzles operate from near the ground level, spraying in an upward and outward direction and thus affording opportunity to apply spray to the stems and under-leaf surfaces (Fig. 6).

An easily operated adjustment is provided on the boomlet staff to elevate or depress the nozzle-placement assembly. Adjustments to individual nozzles for height and both vertical and horizontal angles are obtained in the conventional manner by changing the relative positions of the pipe fittings which make up the assembly.

The shaft from which the boomlets are supported also serves as a power lift, actuated by the tractor hydraulic lift or a cylinder operating on spray pump pressure. Connected to the shaft by a bell crank is a quick-closing valve which serves to shut off the supply of spray to the boom. The valve closes automatically when the boom is raised for turning or transport and opens when the boom is lowered. Details of construction are shown in Fig. 7.

Additional coverage is assured by vine-agitator rods, or spreaders, mounted on the forward end of the ground shoe. These rods life and hold the side limbs of the plant at the correct distance from the lower nozzles for accurate spraying. Vibration of the rods and the forward movement of the unit cause the plants to be moving when passing through the spray cone, thus exposing a greater area of leaf surface than if they were static.

Structurally the boom consists of an angle member to which are bolted clips or bearings for the lift shaft. Boomlets are fabricated by welding 1-in pipe to strap hangers. A shoe of suitable size is welded to the lower end. The vine-agitator rods are welded to the forward end of the shoes and bent to the desired shape (Fig. 5). The water or supply boom is supported by the angle member. Short lengths of hose are used to connect the supply boom to the nozzle assembly which is made up of standard water pipe and fittings. The complete boom can be readily attached to any sprayer.

During the past season, another sprayer of this type was constructed for use by the Maine experiment station. A secondary supply and distribution system of copper tubing for the application of aerosols was added. This type of boom allows for very effective use of this newer method of applying insecticides.

The boom has one drawback in that, as it operates between the rows, the number of boomlets must always be odd. With the conventional tractor, this means that on every other trip through the field, the tractor must straddle two non-matched rows. However, rows are spaced with reasonable uniformity have given no serious trouble.

Twenty-two different types and makes of available and commonly used nozzles have been tested. The greatest objection to the commercial nozzle is that nearly all of them have a dispersal cone of less than 40 deg, which necessitates the operation of the nozzle at a considerable distance from the plants. It would be highly desirable, for obvious reasons, if nozzles which produced an included angle of spray cone of 100 deg or more could be found. An attempt is being made this year on our project to design and construct nozzles which will produce a wide-angle, finely divided soft spray of water-base materials at pressures not to exceed 150 lb per sq in.

Several advantages are obtained from the use of this boom, as follows:

1 Greater total coverage of plant

2 Increased uniformity and distribution of spray material

3 Lower operating pressure (100 to 125 lbs) with consequent lowered costs due to longer life and more economical fittings

4 Affords the operator freedom from boom breakage (due to obstructions or dragging) and freedom from the necessity of boom-elevation adjustments.

Farm Building Construction

(Continued from page 451)

agricultural experiment stations and the USDA Agricultural Research Administration are best equipped by personnel and facilities to undertake this work. In past years, research expenditures by these agencies have totaled a maximum of $200,000 annually; this is about three cents per farm, or one-thousandth of one per cent of the U. S. Census value for farm buildings.

2 *Farmer Education.* Adult education is needed to instruct the farmer in the economic value of good construction for both his family dwelling and his utility buildings. Recent legislation sponsored by the Association of Land-Grant Colleges and Universities to increase appropriations for agricultural extension work will presumably be directed in part to this purpose.

3 *Education of Building Mechanics.* The average age of rural mechanics has been estimated to be well above 50 years. Special education in the specialized needs of this field for war veterans and other young men to supply the skilled mechanics required to implement a large-scale construction program should be undertaken by the U.S. Office of Education, the Veterans Administration, and the state agricultural colleges.

4 *Farm Construction Loans.* A system of long-time amortization loans based on the farmer's ability to repay should be made available through one of the federal farm contact agencies. Subsidized farm housing is unnecessary and is contrary to the wishes of most farm people.

Farm Wagon Gears

TO THE EDITOR:

HOW far have we progressed in the design of farm wagon gears for use on the farm during the past 20 or 25 years?

The first farm wagon I remember had a green box and red wheels. It had high 44 or 48-in rear wheels (lower front ones) and narrow steel tires, which seemed to give best performance in the ruts and mud of the roads of those earlier days, but it had one very serious handicap: you couldn't turn short with it.

Nowadays general-purpose tractors turn within their own length, which is true also of the grain thresher. Some manure spreaders have been made with a forked front end so they will turn on their own wheelbase. But I don't know of a wagon gear, a piece of farm equipment so widely used that has been designed to turn on its own wheelbase. I believe it is possible for an agricultural engineer to design one that will.

A farm wagon gear hitched to a general-purpose tractor governs the angle at which the tractor can be turned. The truth is it takes a generous sized area in which to turn around with such equipment far more than is generally available around a farmyard. Some farmers have designed their own wagon gears and seem to have done a good job at it, especially those fellows who were interested more in real utility than in using an old motor-car chassis simply because it was cheap. *(Continued on page 458)*

Functions of the Soil Conservation Districts in Drainage

By Fred F. Shafer
MEMBER A.S.A.E.

SOIL conservation districts are governmental subdivisions organized by democratic processes under the laws of the states. The objectives of the districts are to conserve soil, moisture, and related resources. The affairs of the districts are directed by governing bodies composed of local farmers or landowners. Districts come into existence only in response to the petition and favorable referendum vote of the landowners and operators carrying on agricultural operations within their boundaries.

The state soil conservation district laws have equipped the districts with the broad range of governmental powers they need to exercise in order to perform their functions well. It may be said, in general, that the districts are authorized to do everything that needs to be done to achieve "the prevention and control of soil erosion and the conservation of soil and soil resources". In the last analysis, soil conservation can be effectively achieved only if all lands are put to their proper use. In general, the districts are authorized to do whatever is essential to achieve that objective.

The districts do not have authority to levy taxes or lay assessments, but they may request and receive aid from state and federal agencies and from private sources. The Soil Conservation Service is authorized by Congress to furnish assistance to soil conservation districts. Such service assistance usually consists of technicians assigned to districts for their use in helping individuals and groups of farmers plan and install their conservation practices. Equipment may be made available to districts for carrying on conservation operations where such equipment is not readily available from local sources. It usually consists of heavy construction equipment, or machines not generally used in the district. The SCS encourages districts to consider assistance rendered by it as being supplemental to that which may be provided by local agencies, through contractors, or by state and other federal agencies.

Conservation plans provide for the safe disposal of surplus runoff. In poorly drained areas, or on lands subject to overflow, the runoff-disposal system will usually include drainage works. This brings the districts squarely up against the drainage problem at an early stage of operations. Not only is the district confronted with the problem of assisting individual farmers in planning and installing their drainage works, but adequate outlets beyond the boundaries of the farm must be provided. This may involve repairs or rehabilitation work in connection with a drainage district or action by mutual consent of a small group of farmers having a common outlet problem.

Soil conservation districts, organized in areas where drainage is of vital importance, cannot ignore or neglect these responsibilities in providing assistance to the extent of their ability and authority. As a matter of fact, a considerable number of soil conservation districts in this region has been organized for the main purpose of getting assistance to improve drainage conditions generally.

The upper Mississippi Valley region (Region 5) of the Soil Conservation Service comprises the states of Minnesota, Iowa, Missouri, Wisconsin, Illinois, Indiana, Ohio, and Michigan. To illustrate the importance of drainage in this region, some significant figures may be of interest. The total area of the eight states is 288,159,360 acres. Of this amount 53,822,510 acres have been included in organized drainage enterprises and assessed for benefits for construction. The area in drainage enterprises is 18.7 per cent of the total area of these states, and 25.7 per cent of all land in farms.

The work done under the enterprises cost $404,720,000, which is an average of $7.51 per acre. Construction included 101,756 miles of open ditches and 54,500 miles of tile drains.

It is difficult to estimate how much may have been spent for private drainage in addition to these public drainage enterprises. A complete tile drainage system on heavy soils probably costs in the neighborhood of $40 to $60 per acre. The other extreme would be simple types of open ditches where the cost probably would not exceed $2 or $3 per acre. It is believed that private expenditures will equal the amount spent through enterprises, or $7.50 per acre. If this factor is applied to the 35,380,000 acres, estimated as treated by farm drainage, the cost is $265,350,000.

Adding this amount to the $404,720,000 invested in public drainage gives an estimated over-all figure slightly in excess of $670,000,000. These figures have been presented to indicate the great importance of artificial drainage in the states comprising the upper Mississippi Valley region.

Accomplishments in Drainage. While soil conservation districts are just beginning to be faced with this problem, they have already begun to secure some accomplishments. Our records indicate that soil conservation districts constructed 83.7 miles of open ditches in 1943, which required moving 611,434 cu yd of earth. The area directly benefited by this improvement was 63,435 acres on 475 farms. The approximate cost was $95,000. This represents about 30 to 35 jobs, fully 80 per cent of which were conducted as mutual organizations.

In addition to this work, 458 miles of surveys were made with plans and estimates prepared for construction. The area to be benefited by these plans is approximately 175,000 acres and estimated cost is in excess of $2,000,000.

Drainage improvements, as a part of complete farm plans, were installed on 9,525 acres. Most of this was in the form of tile drainage. Complete farm plans include soil and moisture conservation practices, as well as drainage practices.

These few specific examples will help illustrate the effectiveness of district operations in drainage work.

The following report, made by the conservationist for the Montgomery County (Illinois) Soil Conservation District, covers the period from the latter part of 1942 to April 30, 1944. Practically no construction work was done until 1943 so that the actual time covered is about 16 months:

1 Number of drainage jobs completed as of April 30, 1944	15
Total number of acres benefited	17,022
Total number of farms benefited	164
Total miles of ditch cleaned	28.9
Total cubic yards of earth excavated	111,900
Total estimated cost	$14,500
2 Number of jobs under construction on April 30, 1944	3
Acres benefited by these jobs	5,790
Number of farms benefited	60

This paper was presented at the annual meeting of the American Society of Agricultural Engineers at Milwaukee, Wis., June, 1944, as a contribution of the Soil and Water Division.

FRED F. SHAFER is drainage engineer (Region 5), Soil Conservation Service, U. S. Department of Agriculture.

Miles of ditch to be cleaned		7.5
Cubic yards of earth to be moved	57,000	
Estimated cost	$7,500	
3 Number of jobs surveyed and plans prepared for construction	5	
Acres which will be benefited	7,840	
Number of farms benefited	83	
Miles of ditch to be cleaned		24.1
Cubic yards of earth to be moved	97,130	
Estimated cost	$12,650	
4 Number of surveys in progress	2	
Acres in districts being surveyed	6,060	
Number of farms involved	59	
Miles of ditch to be cleaned		17
Estimated cubic yards to be excavated	73,000	
Estimated cost of jobs	$9,500	
5 Number of applications for assistance on file with soil conservation districts and for which no surveys have been made	5	
Estimated acreage to be benefited	4,150	
Estimated number of farms benefited	36	
Estimated miles of ditch to be cleaned		7.8
Estimated cubic yards of excavation	41,000	
Estimated cost of jobs	$5,350	

The soil conservation district furnished technical assistance for survey plans and supervision. It also furnished draglines for most of the excavation. A charge of 12 to 15c per cu yd is made by the district for use of the machines, which is about the same as local contract prices.

The Knox County (Indiana) Soil Conservation District reports the following activities in drainage for the calendar year 1943:

Number of jobs completed	11	
Miles of ditches dug and cleaned		10.61
Acres of land benefited	2,620	
Cubic yards of excavation	136,100	
Total cost of jobs	$14,740	
Number of jobs surveyed with plans ready for construction	7	
Miles of ditches involved		10.92
Acres of land to be benefited	1,380	
Estimated cubic yards of excavation	113,000	
Estimated cost of jobs	$12,400	

A survey of 15 miles of ditches was in progress at the end of the year. The area to be benefited is about 5,000 acres and the estimated cost is about $30,000.

The soil conservation district furnished technical services only. All construction work was done by private contractors. Practically all of these jobs were done by mutual organizations.

These two examples are from districts where drainage constitutes one of the major problems. It must be understood that drainage is only one of the soil conservation activities carried on in these districts.

Three other major projects were investigated during the year at the request of landowners in soil conservation districts where detailed surveys and other studies were made to determine the feasibility of flood protection and drainage.

A survey and study was made of the Nishnabotna River bottomlands in the Fremont County (Iowa) Soil Conservation District. This project involved investigating the best method of protecting 14,000 acres of bottomland from overflow. The estimated cost of the job is about $1,000,000 which makes the feasibility of this project very questionable.

Another preliminary survey for flood protection was made along the Boyer River in Crawford County, Iowa. The area involved is about 5,000 acres, and the estimated cost of the job is about $225,000. This job is now being organized under state drainage procedure.

The third large project was a survey of the Spring Creek Watershed in the East Agassiz Soil Conservation District in Norman County, Minnesota. This project involves both drainage and flood control on a watershed area of 95,000 acres, of which 60,000 acres would probably be benefited. Plans have not yet been fully developed, but a preliminary estimate indicates that the job, if carried out as is now contemplated, will cost about $650,000. Two temporary storage basins are being considered as a part of the proposed improvements.

How Soil Conservation Districts Aid Landowners. There are four ways in which soil conservation districts assist landowners in their drainage problems: (1) They supply technical services for making full examinations, topographical surveys, and economic studies of the practicability and feasibility of the drainage; (2) complete plans, specifications, and estimates are prepared for whatever improvements are considered necessary; (3) where earth-moving equipment is available to the district, it may be used in the construction of the improvements where contractor services are not available at reasonable cost, and (4) technical services are usually supplied to supervise the construction and to see that the work is properly done. The interest of private engineers in such work is recognized by the Soil Conservation Service and the employment of drainage engineers by drainage districts, especially the larger ones, is encouraged in carrying out the programs.

The applications for drainage assistance fall into three categories, namely, (1) from officials or landowners of organized drainage and levee districts, (2) from a group of unorganized landowners having a common outlet problem or other damage from lack of drainage, and (3) from an individual landowner who has drainage problems on his land.

The method of handling each type of application differs somewhat. Where requests for assistance are made by officials of organized enterprises, the engineering technicians of the soil conservation district usually make a preliminary inspection of the area accompanied by representatives of the drainage enterprise. If the organized enterprise is of the drainage-district type, arrangements for work are often made directly with the governing body of the drainage district.

If the drainage enterprise is of the county-drain type, an investigation is made of the county records of the ditch to determine the original design, the cost, and the assessed acreage. An investigation is made to determine whether the proposed job is feasible.

Where the investigation shows that the project is feasible, the soil conservation district officials arrange a meeting of landowners who would probably be benefited by the improvement. At this meeting the sentiment for and against the improvement is canvassed. The method of handling the procedure is likewise discussed. Occasionally it is possible to reach an agreement among the landowners at the first meeting whereby they will organize themselves into a mutual group to finance the construction. Usually two or three landowners are selected by the group to act as officers to handle the business incidental to contacting landowners, such as arranging for right of way, collecting the necessary funds, and handling the contracts, payments, etc.

If the sentiment indicated at the meeting has not crystallized or appears divided, no attempt is made to form an organization at the first meeting. This mutual-type procedure is of course applicable to unorganized groups not in a drainage enterprise. Occasionally it may be necessary to abandon a mutual form of cooperation and advise the interested landowners to petition for the improvement according to the state laws governing such procedure.

It is interesting to note that the great majority of group enterprises, with which soil conservation districts have co-

operated, have been of the mutual type. In one case there were about 75 or 80 landowners involved who raised $18,650 by voluntary contributions. There are several advantages in handling a drainage enterprise through a mutual agreement. Probably the greatest advantage is saving certain overhead costs, such as attorney's fees, court costs, engineering commissioner's fees, etc. These costs usually run from 10 to 20 per cent of the total. Another decided advantage is that considerable time is saved. It is seldom that a court procedure petition can be carried through to the point of letting a contract in less than 4 to 6 months, and very often much more time is required.

When the landowners concerned with the improvement have agreed to carry it through, a memorandum of understanding is signed by the officials of the soil conservation district and the officials of the drainage enterprise if the enterprise is one that has been petitioned to go through court procedure. If the enterprise is a mutual organization, then the memorandum of understanding is between the soil conservation district officials and the selected representatives of the landowners.

After this memorandum is signed, the soil conservation district arranges for necessary surveys and plans to be made. When the plans and estimates are ready, the soil conservation district officials prepare a "working agreement" which stipulates who will do what. This working agreement usually includes the plans, estimates, and specifications. If the organization is functioning under the state drainage procedure, the plans may be turned over to the county drainage officials for taking bids, letting contracts, etc. If the soil conservation district is to supervise construction, the working agreement will so specify.

In many cases there are other problems in the watershed in addition to lack of adequate drainage; there may be erosion conditions that are contributing large amounts of silt which may tend to fill the ditch channels. In some areas wind-blown fine sand and silt may be a troublesome problem. The soil conservation district officials may require that plans for improving uplands be made as protection to the drainage improvements. Such plans would be worked out with the individual landowners, and would likely consist of strip cropping, contour cultivation, terraces, grassed waterways, or whatever methods the district technicians find applicable under the local conditions.

Advantages of Soil Conservation District Management and Operation. In preceding paragraphs of this paper the ways in which soil conservation districts function in connection with group drainage enterprises were discussed. The advantages of such assistance may be summarized as follows:

1 In soil conservation districts the utilization of land in accordance with its capabilities is the basis for planning conservation measures. Drainage assistance will be provided only for lands suitable for agricultural production. The determination of land capabilities is among the first investigations made where assistance on a drainage problem is being considered.

2 The districts may call upon many sources for advice and assistance on their various problems. There is public interest and support for the work of the soil conservation districts that drainage enterprises do not enjoy. The soil conservation districts can bring to drainage organizations within their boundaries public support that could not otherwise be secured. It should be understood, however, that each functions in a way to supplement but not to displace the other.

3 On small group outlet problems, where it is not feasible to organize drainage enterprises in accordance with state laws, the soil conservation districts may provide assistance to mutual-consent groups for the solution of their problems.

4 Soil conservation districts have the responsibility for assisting farmers in securing better land use and physical land improvements through drainage. They do not approach such problems with the intent of promotional development that has been responsible for the past failure of many drainage enterprises.

5 The soil conservation districts can exert direct influence for proper maintenance of drainage works through periodical inspections and by bringing to the attention of drainage officials the need for repairs. Projects that have been constructed are followed up and cooperators who fail to maintain their drainage works may be placed in low priority for other assistance.

6 In the ordinary drainage enterprises, organized in accordance with state laws, no work may be done on lands not directly benefited by the drainage construction. Rolling cultivated land in a watershed being drained usually contributes large quantities of silt which finds its way into the drainage channels and necessitates rather frequent cleaning. Similar jobs, which are handled through soil conservation districts, are studied from the standpoint of possible silt deposits and every effort is made to provide erosion control through farmer cooperation.

7 Many of the open-ditch rehabilitation jobs are designed and constructed for their demonstrational values. For efficiency of operation and maintenance, special emphasis is placed on the following improvements: flatter bank slopes, spoil banks leveled and seeded, adequate water gates at fence crossings, structures to prevent bank gullying from concentrated surface water, tile outlets into the ditches protected by permanent pipes or structures, and substantial farm bridges.

8 Earth-moving equipment may be secured by the soil conservation district for construction of drainage improvements where contractor equipment is not available at reasonable prices.

9 Where adjoining drainage enterprises have problems of mutual interest, an impartial agency, having skilled technicians available, is at hand to assist with their solution.

In conclusion, soil conservation districts offer new possibilities for drainage improvements in addition to the opportunity for soil and water conservation. It should be recognized, however, that soil conservation districts cannot take over the functions and responsibilities of drainage enterprises organized in accordance with state drainage laws. The latter have the responsibility for and authority to assess lands for benefiting, finance the cost of construction through sale of bonds or other measures, exercise the right of eminent domain, levy maintenance taxes, construct and operate drainage facilities. Efforts are being made to coordinate drainage with upland soil treatment so that all water-disposal problems may be handled largely from a watershed basis.

Farm Wagon Gears

(Continued from page 455)

Much progress has been made in improving the design of farm wagons, particularly the units mounted on antifriction bearings and rubber tires, but we are still a long ways from developing a satisfactory short-turning wagon gear for farm use. Can't something be done about it? Perhaps we should go back to the two-wheeled trailer idea (usually called a "cart"); it did turn short. The two-wheeled, tractor-drawn manure spreader has this advantage.

"Wisconsin Farmer"

Improvements in Equipment for Killing Both Larvae and Adult Mosquitoes with DDT

By Fred W. Knipe
MEMBER A.S.A.E.

THE rapid increase in the use of insecticides such as pyrethrum and DDT for destroying malaria-carrying mosquitoes has created a demand for equipment adapted to the various techniques which have been developed for applying these substances. DDT, for example, may be applied as a powder or as a liquid spray; and furthermore, as a liquid spray it is useful in malaria control both as a fine dry mist and as a reasonably large droplet wet spray. Each method of application requires specialized equipment. Results obtained by numerous investigators throughout the world over a period of years all tend to establish agreement on the types of sprays most effective under the varying conditions encountered. The different types are discussed briefly in the following paragraphs.

Pyrethrum Applied as a Dry Spray. Pyrethrum sprays, whether used alone or activated by the addition of certain other agents, apparently are rapidly lethal to mosquitoes. There may be some slight repellent effect also. But the residual effect of pyrethrum sprays is brief. Consequently it would seem that such sprays should be applied only as finely divided "dry" droplet sprays, as typified by aerosols. These sprays diffuse rather rapidly through the area undergoing treatment, by means of convection air currents. Little or no effort need be made to assist in their diffusion..

Application of this type of spray has been successfully carried out, notably by use of the aerosol dispenser bomb. About the time the aerosol bomb was developed, certain hand-operated spray guns were perfected which were much less costly to operate than the bomb and which proved to be efficient in producing small air-borne droplets of pyrethrum spray[1]*. Certain other equipment both of the external air compressor type[1] and of the internal generating or solidified carbon dioxide type[2] had also been developed. These spray guns have not undergone changes in principle, but have been modified in design.

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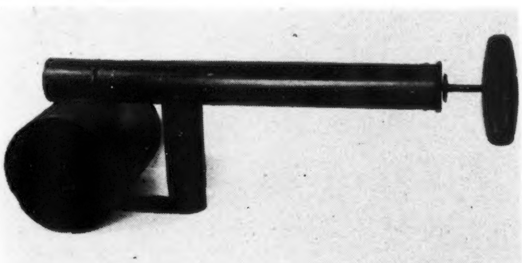
*Superscript numbers refer to appended references.



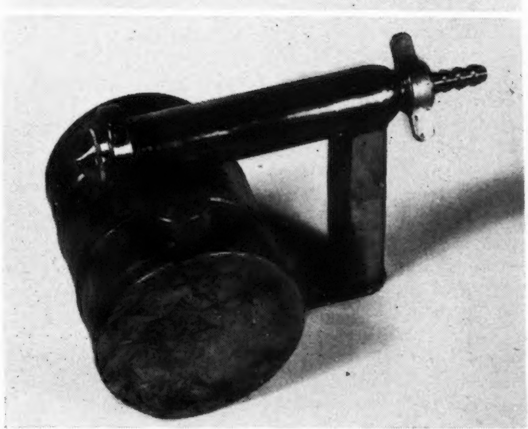


Fig. 1 (Top) The type of hand-pumped spray gun designed for use with pyrethrum and manufactured for the Allied Commission (Italy) • Fig. 2 (Bottom) The type of hand spray gun (without pump) with adjustable fan-shaped spray nozzle designed for use with any convenient low-pressure air supply

DDT in Mosquito Control. DDT seems to fulfill the twofold requirement of the malaria investigator for a lethal agent effective against both mosquito larvae and adults and characterized by a dominating residual effect. It is a rapid killing agent, when used as a dry-mist-type of spray, although slower than pyrethrum against adult mosquitoes. It is also a residual killing agent, the long-lasting properties of which are, as yet, not fully understood.

The use of DDT in mosquito control has created two main problems. The first of these is the problem of application for quick control of both larvae and adult mosquitoes. This requirement may be met with techniques already known and at hand, but the techniques must take into consideration the behavior of the lethal properties that characterize the new agent. The second problem — that of residual effect — must for the most part be solved with new or improved types of mechanical equipment. We shall consider first the matter of immediate control of larvae and adult mosquitoes.

Application of DDT as a Larvicide. The answer to the problem of immediate control of larvae with DDT lies in the use of old-line methods of distributing oil on water, as typified by the knapsack sprayer. However, one advantageous factor appears, namely, the small amount of DDT mixture required for lethal effect on larvae. The quantity has been reported to be as low as one or two quarts of DDT-carrying oil per acre. This small quantity spread over large water surfaces involves a new technique in distribution. Fortunately, former objections to the use of oil do not arise when the DDT-oil mixture is used, since the quantity required is so small.

DDT Applied as a Dry Spray. Killing of adult mosquitoes with DDT dry-mist sprays seems to follow the technique developed for use of pyrethrum. Both insecticides may be applied from aerosol bombs, from hand-operated spray guns, or from power-driven equipment. The main difference between the two agents appears to be in the spread of lethal action. Pyrethrum acts quickly, frequently killing mosquitoes within a few seconds. DDT is relatively slower, requiring perhaps as long as 20 minutes to kill. If a spray could be developed containing both of these toxic agents, which would take advantage of the desirable properties of each, the combination would be de-

sirable. It would be necessary, however, to provide for rapid diffusion of pyrethrum through the air and deposition of DDT on mosquito-resting surfaces. But since, in order to be most effective, one agent must be diffused as a dry spray and the other as a wet spray, it may be difficult to combine these characteristics in a single spray.

Since the same equipment may be used for distributing DDT in the form of a dry mist as is used for the application of pyrethrum, no change in technique of distribution need be involved. In other words, problem one, that of immediate control of adult mosquitoes and larvae remains practical with equipment already available, if and when residual effect is not considered. On the other hand, modifications of certain equipment may tend to make distribution of the insecticide somewhat easier for the workmen employed in the operation.

DDT Applied as a Wet Spray. The second problem, which perhaps has automatically become the main issue for the malaria investigator, is to make effective use of that property of DDT which every person interested in malaria control has dreamed about for many years — the startling residual effect. Even now the challenge of this effect has undergone only relatively preliminary investigations. But these studies seem to indicate that mechanical distribution of DDT, by one means or another, will be required. This distribution must not impair the properties of DDT, it must be adequate, and it must be economical both in operational cost and in the distribution of the product involved.

Admitting the foregoing statements to be true, it has occurred to some investigators that the time has arrived to cease endeavoring to remake equipment to fit this work. These persons believe that newly designed or developed equipment should be produced specifically for malaria control. Quite naturally, though, full advantage should be taken of any desirable characteristics in existing equipment. For instance, both agricultural-spraying equipment and paint-spraying equipment are well developed within their respective fields. Somewhere between these two, malaria-control-spraying equipment seems to lie. In this field additional developmental work appears necessary.

Amount of DDT to Apply to Surfaces. There have been several suggestions by investigators regarding the optimum of DDT which should be deposited on a given unit of wall surface. By what factors is that amount determined? Does the same unit of deposition apply to all adult mosquito resting surfaces? If a wall is properly covered by DDT crystals and if mosquitoes alight on that wall for brief periods, those mosquitoes are supposed to die. It has been well established that the crystals on some walls retain this lethal effect as long as 90 days or more. If effective 90 days, then why not for longer periods? Do the crystals deteriorate on exposure to air? Are they in some way dislodged from the wall, or are they absorbed by the materials of which the wall is constructed?

The foregoing questions are proposed because the amount of DDT applied to the wall surface may influence the time limit of the residual effect of the poison. The quantity which may be applied to a wall surface probably is limited by the capacity of that wall coating to absorb oil and DDT. Therefore the question arises, what is the optimum dosage which should be applied to a particular wall in order to retain the longest possible effect? Furthermore, the development of equipment may depend upon the quantity of material which should be deposited on a unit area and upon the quality of spray needed to insure this deposit.

Equipment for Distribution. It has been suggested by several investigators that a 5 per cent DDT-kerosene or fuel oil mixture deposited at a rate of 1 qt per acre would be an excellent lethal dosage to use on water surfaces against mosquito larvae. These investigators usually point out the difficulty of securing the fine atomization of oil particles required to spread lethal mixtures as thin as this. Fine atomization may be procured with paint-spraying equipment, but such equipment usually cannot be transported economically to and through wet areas to points where it is needed. Ordinarily oil-spraying equipment as well as hand-operated spray guns distribute sprays too rapidly or in droplet sizes much too large to cover an acre of water surface completely with such a small amount of liquid.

Fig. 3 This shoulder strap may be used with the hand-pumped type of spray gun to reduce fatigue of the workman

Hand-Operated Spray Gun. A type of hand-operated gun has been developed, however, which will deliver droplets of sufficient micron size at rates low enough to permit coverage of one acre with one quart of liquid. The two guns shown in Figs. 1 and 2 are essentially the same, except that the one in Fig. 1 is activated by a self-contained air pump, while the other (Fig. 2) uses an independent air supply. Both operate efficiently on pressures between 0.5 and 1.0 atm (atmosphere) (7 + to 14 + lb per sq in). One millimeter is the size recommended for the internal and for the external orifices. With a working pressure of 0.5 kg/cm² (one-half atmosphere) this combination of orifice may deliver as little as 2.5 cc of DDT-oil per minute in a form which may all be spread by air currents. The nozzles of the two guns, as illustrated, are not the same. In the gun in Fig. 1 the nozzle is fixed in position and delivers a round spray. The one in Fig. 2 is an adjustable nozzle which delivers a fan spray. Adaptation of either nozzle may be made to either gun, as local conditions may dictate.

An adjustable nozzle has been designed for this gun, the range of which, at 1 atm pressure, is approximately from 2.5 to 110 cc per min. It must be realized that, at such low pressure, the greater the amount of spray delivered, the larger the droplet becomes. When the discharge is at a rate of 54 cc per min, an excellent pyrethrum-type spray is delivered. Above this rate of delivery the droplets become rather large for an ideal pyrethrum spray, but do rapidly change to a good wet spray such as may be used for spreading DDT on walls and other surfaces.

The self-contained pump and hand spray gun combination operates on the same principle as the earlier developed "Cobra" sprayer[1]. Alterations and modifications in construction details are the only changes.

The spray head without the self-contained pump is a development to meet more varied conditions of service. Air pressure may be delivered to it from any number of external sources, among which may be included solidified car-

bon dioxide, hand-pumped knapsack air-pressure tanks, unit power-driven air-compressor equipment of many types and descriptions, and lightweight internal-combustion-engine exhaust fumes.

Air Pump. In order to meet an urgent need, an air pump which may activate the spray head has been developed and perfected. The specific reason for designing it was the demand for a continuous supply of air which could be developed by one man in a manner similar to the action of the ordinary knapsack oil-spray pump. Pressures varying up to $2\frac{1}{2}$ atm may be developed by it.

Knapsack Tank. Since the air pump had to be mounted on some sort of base to give it stability for operation, and since a certain amount of DDT-oil supply may be conveniently carried by the operator, a specially designed knapsack tank was developed to serve both purposes. This tank may contain the necessary DDT-oil supply for several hours work. The air pump has been mounted on the side of the tank, from which position it may be conveniently manipulated by the operator. Air is pumped through a hose directly to the spray gun.

The tank is mounted on the back of the operator in more or less the conventional manner and is held in place by a strap 45 mm wide made of double webbing. A special leather pad is strapped over the chest of the operator in order to aid in steadying the reciprocating motion of the pump. This pad materially eases the strain on the operator. The complete apparatus may have its primary usefulness where considerable areas of larvae must be sprayed with a DDT-oil combination and where the operator would lose time if it were necessary for him to return to a central point to refill his spray gun.

Where it is possible to spread DDT-oil over water-covered areas by means of low-velocity air-current diffusion, either of the above-mentioned guns may be used. With either gun, distribution of material over a given area will depend entirely upon the time element, since the gun discharge rate is low. In other words, if the gun in question discharges at a rate of 75 cc per min, a conservative amount of 1 atm pressure, then the time required to discharge 1 qt of liquid would be about 12 min. The operator would have to judge the distance he must advance during this time interval in order to cover one acre of water surface with the larvicide.

Shoulder Strap. In case the hand-pumped gun is used and becomes burdensome, it is recommended that a strap be passed over the shoulder and through the pistol grip (Fig. 3) in order to relieve strain on the operator's arm. This practice has been tried out and has proved to be advantageous.

In case the hand gun is activated by the air pump attached to the knapsack tank, the tank may be filled with DDT-oil if so desired, or may remain empty in order to lessen weight.

Back Brace Mounting. Another type of support for the air pump has been designed as a back brace. Two factors prompted this design. One has reference either to out-of-door or to indoor use; the other has reference to indoor use only.

The back brace is built up of band iron strips, 35 mm wide and 2 mm thick, welded and bolted together. It is supported on the back by webbing in a similar manner to the knapsack sprayer. A chest pad (Fig. 4) helps to absorb the motion of the pump. A felt strip rivetted to the brace protects the back of the operator from any abrasive action of the iron.

It will be noted that the back brace may eliminate the need for the knapsack spray tank altogether. The brace is designed to mount either one or two air pumps (Figs. 5 and 6). If only one spray gun is to be used by a single operator, either in a house or out-of-doors, then only one pump need be mounted on it. With this combination an operator may spread DDT-oil on water surfaces to kill larvae, he may spray probable mosquito resting places, or he may spray adult mosquitoes. However, since the weight of the tank and of the brace is about the same, there is little advantage from this point of view in the use of one over the other.

The advantage of the back brace may be in the desirability of using two air pumps under certain conditions. One of these suggested conditions is in spraying walls with DDT-oil in houses or in other relatively confined quarters where one man cannot advantageously operate an air pump and apply spray to a resting place at the same time. In this case two operators may work together. One man operates the spray gun, which is connected with the air pump by a rubber hose somewhat longer than that used by a single operator. This operator is free to move about, applying spray to walls behind obstructions, under beds, and to other out-of-the-way places, his movements unhampered by the necessity of pumping air. He can thus accomplish a more uniform job of spraying walls more rapidly and with less likelihood of damaging furniture.

The second operator of this team has the brace mounting two pumps attached to his back. Each pump is operated by a non-tiring reciprocating arm motion. Hose leads from the individual pumps join into a single line at an appropriate point and carry the air to the spray gun.

This combination also has advantages when used in small storage outbuildings where the workman cannot con-



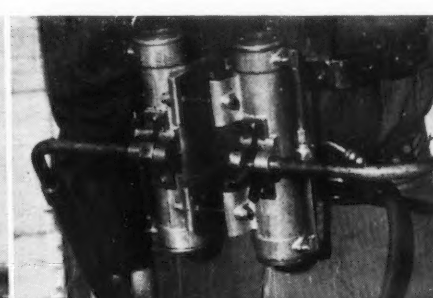


Fig. 4 (Left) Chest pad for use with back brace • Fig. 5 (Center) Hand spray gun in use. Two hand-operated air compressors are mounted on the back brace. Compressors are operated by reciprocating arm motion. One compressor will satisfactorily supply air to one gun. Two or three guns may be operated from this air supply • Fig. 6 (Right) Close-up of mounting of air compressors on the back brace. Note the felt lining covering the lower part of the brace. It is rivitted to the brace and protects the back of the operator

veniently operate the pump and spray wall surfaces at the same time. Another place it may be employed to advantage is where the man using the gun must constantly climb over constructions, or must spray walls difficult of access.

Types of Spray Patterns, Round and Fan. The apparent requirements of a wall spray are (1) adequate and complete coverage, (2) a spray which will remain effective for the greatest possible time, and (3) a spray which will do no damage and will leave no stain on those surfaces where stains would affect appearances.

Two general patterns of sprays are delivered by spray-gun nozzles, namely, round and fan-shaped. "Pattern" apparently need not be considered when larvicidal applications are being made or when adult spray killing is the sole objective. The round pattern or the fan pattern both serve the same purpose in this instance. But "pattern" is an important consideration when a residual application is made within structures, on walls particularly. When walls are sprayed, in reality a light coat of "paint" is being applied. Paint guns usually use the fan pattern to spread paint on such surfaces, primarily because this pattern may be more easily controlled. The same principle applies to the uniform and economic application of DDT-oil. This control is particularly necessary where extreme care must be taken in order to avoid damage to the wall covering. Specifically, on rough wall surfaces as in barns, storehouses, pigsties, etc., oil stains on the wall are no problem. But in the well-furnished house, where drapes cover windows, where walls are papered or perhaps painted, or as in some instances, where fine fabrics cover the walls, it becomes necessary to "paint" those walls with a pattern which is under full control of the operator. This technique requires a fan type of spray.

Efforts have been made locally (Italy) to develop nozzles which will deliver fan patterns under all conditions, whether the spray is delivered as a product atomized with an admixture of air or whether atomized by a whirling motion as is used in most sprays developed by high pressure on the liquid, but without an admixture of air. Spray nozzles of this type have been developed for adaptation to the hand spray gun and to the type represented by the Dobbins superbuilt sprayer.

The nozzle developed for the hand spray gun produces an excellent fan which may be used, if adequately controlled, wherever particular care must be taken with regard to wall stain damage.

The whirl-spray fan pattern is an improvement over the round pattern. Application of spray with it is more easily observed and may be more uniformly controlled by the operator. The orifice is very small, necessitating the use of a fine-mesh nozzle screen in order to prevent clogging.

Extension Arms. One of the limitations found when applying DDT-oil to wall surfaces was the difficulty of quickly and adequately "painting" high walls and ceilings. Since the principal resting places of adult mosquitoes in this region (Italy) are usually in dark corners of walled spaces, near or on the ceiling, it is necessary to apply spray directly to those resting places in order to secure maximum effectiveness.

No commercial apparatus available seemed to have a lightweight extension arm with nozzle attached, which could be used for the purpose. Some extension arms were imported from America for trial in this work. The arms and spray heads operate satisfactorily, but one of the extensions which is only 3 ft in length is entirely too heavy for an operator to use for long periods. Consequently various apparatus has been designed to meet this situation.

One development was a lightweight extension arm $1\frac{1}{2}$ m in length, designed and built for adaptation to the Binks Thor 17 gun. This extension operates very satisfactorily and, for its length, is not heavy. But many walls cannot be adequately treated with such a short extension arm. Some walls, especially in barns, are 4 to 5 m high. The extension made for the Binks gun would become too heavy and unwieldly if made that long.

Extension poles have also been developed for adaptation to knapsack spray rigs, as represented by the Dobbins superbuilt sprayer. These poles are extensions, to the required length of the original spray-head assembly. They were made up from 6 m/m copper or aluminum pipe acquired from military salvage dumps. The pipes were run through appropriate holes drilled lengthwise through bamboo poles. Bamboo poles are light in weight and strong, thus affording protection to the small pipe. Connection was made to the hose leading from the knapsack in the conventional manner, through the necessary shutoff valve. The outer end of the pipe line was fitted with the conventional spray nozzle. Just back of the nozzle, the pipe line was bent to an angle of approximately 30 deg. When placed in service, this permits the operator to stand well back from the wall, where he may better observe his work and still hold his spray nozzle parallel with the wall surface. When he wishes to spray the ceiling, he turns the bamboo pole through 180 deg, stands in proper position on the floor, and holds the spray nozzle parallel with the ceiling. A decided advantage of this construction from the point of view of the operator is the fact that he need not stand immediately under the point being sprayed. This saves his eyes and his clothing from exposure to such of the kerosene-DDT droplets as do not adhere to the wall or ceiling but fall to the floor.

It must be understood that two operators are required to manipulate this apparatus. One man operates the pump, keeping up a uniform pressure; the second man does the actual spraying. Necessarily, a hose about 3 or 4 m long is required to connect the two operating elements.

Flexibility, or the ease with which the necessary spray apparatus may be moved about from structure to structure, as well as the ease of operation of that equipment within the structure, must be considered where effective spraying is to be undertaken. Time is always an objective. If a burdensome piece of apparatus, heavy to move and unwieldly in operation, is to be used, then much time will be consumed and probably an unsatisfactory job will result. On the other hand, if easily portable, lightweight equipment is used, a better piece of work may be expected and the time element will be reduced.

As a case in point, a heavy engine-driven air compressor, mounted on an inadequate wheelbarrow type of transport unit is, of itself, difficult to move from place to place. If it is further complicated by attachment with a hose 16 or more meters long to a heavy paint container full of liquid, which must be transported as a separate unit, then the problem of mobility becomes complicated. Now add to this two hose (liquid and air) each 16 to 45 meters long, and the complication attending movement becomes so great that the outfit becomes highly inefficient from the point of view of time. Long hose are necessary because the pumping unit cannot always be taken into the structure to be treated. Gas engines which are running should not be taken into barns because of the fire hazard involved. They cannot be taken into most houses and certainly cannot be carried up and down steps from one floor to another. Therefore, long hose are necessary in order to reach the objectives.

Experience seems to indicate that one such unit, requiring at least five men to operate it, is not more efficient than one knapsack spray unit using only one or two men to operate it. Only in large struc- *(Continued on page 464)*

Soil and Water Losses as Affected by Rainfall Characteristics

By J. H. Neal

MEMBER A.S.A.E.

THE factors which affect runoff can be grouped under two heads, namely, precipitation and watershed characteristics. On the clay and loam soils of the southeast section of the United States, precipitation is by far the most important, especially heavy rains preceded by other heavy storms. If rainfall characteristics are known, the watershed characteristics can be changed to control soil loss partially, if not the runoff.

Baver[1] developed the *A, I, M,* factors in which *A* is the amount of rain in a storm, *I* is the maximum 5-min intensity of the storm, and *M* is the moisture factor. *M* is the sum of the calculated values of precipitation divided by evaporation for the month under consideration and for the previous month. Horton[2] divided rains into A and B storms based upon their occurrence with relation to previous storms.

Classification of Rains. In Alabama and a number of the other southeastern states, the winter precipitation starts the latter part of November or in December and continues into March or April. At Auburn, the maximum monthly precipitation for the year occurs in March. From the middle of April to the middle of June, the precipitation is relatively low. The summer rainy period starts in the period from the middle of June to the first of July and continues until about the middle of August. From the middle of August on through November, the precipitation is again low, with October being the lowest. There is usually an interval of 30 to 40 days in this period in which there is practically no precipitation. The monthly precipitation for Auburn during the period 1939-44 inclusive, is given in Table 1.

TABLE 1. MONTHLY PRECIPITATION IN INCHES AT AUBURN, ALABAMA

Month	1939	1940	1941	1942	1943	1944	30-year average
Jan	4.84	6.06	2.88	4.50	5.54	4.26	4.62
Feb	9.89	5.72	3.22	3.94	1.50	5.58	5.51
Mar	7.07	7.91	4.02	8.84	15.80	12.38	5.77
Apr	4.30	2.53	3.04	2.22	2.58	11.58	4.38
May	2.86	2.92	0.84	4.00	4.46	1.61	3.75
Jun	3.73	8.32	4.46	6.21	1.73	1.83	4.04
Jul	4.05	7.41	4.97	3.40	4.98	5.97	5.49
Aug	9.33	3.33	5.21	6.05	4.02	11.03	4.68
Sep	4.00	0.90	2.92	3.80	3.06	6.22	3.18
Oct	0.10	0.26	2.62	2.30	0.72	0.36	2.99
Nov	0.43	4.06	2.24	1.84	4.44	3.37	3.38
Dec.	3.35	6.54	10.60	9.34	4.00	2.89	5.79
Total	53.95	55.96	47.02	56.44	52.83	67.08	53.58

It has been observed that under certain conditions rains will produce a high runoff, while similar rains under different conditions do not produce any runoff. It was also observed that for rains which occurred with similar intensities and magnitudes and on soils with similar moisture conditions, the amounts of runoff were similar. Therefore, a classification of the rains was made according to their intensities and the previous rainfall occurring the preceding 10 days. Four classifications were made starting with those rains giving the least amount of runoff. These classifications are given in Table 2.

TABLE 2. CLASSIFICATION OF RAINS ACCORDING TO INTENSITIES AND PREVIOUS RAINFALL

Class No.	Description
1	Previous 10-day rainfall $<$ 1.00 in, and 30-min intensity $<$ 0.50 in/hr
2	Previous 10-day rainfall $<$ 1.00 in, and 30-min intensity 0.50 in/hr or more
3	Previous 10-day rainfall 1.00 in or more, and 30-min intensity $<$ 0.50 in/hr
4	Previous 10-day rainfall 1.00 in or more, and 30-min intensity 0.50 in/hr or more

It was observed that class 3 and 4 rains, which produced the greatest amount of runoff, occurred to a large extent during the months in which the heaviest rainfall occurred.

TABLE 3. SEASONAL DISTRIBUTION OF RAINS OF 1.00 INCH OR MORE ACCORDING TO THEIR CHARACTERISTICS, 1939-1944 INCLUSIVE

Month	Number of Rains According to Class Number 1	2	3	4	Total
Jan	1	7	1	6	15
Feb.	0	1	4	4	9
Mar	3	5	4	14	26
Apr	3	4	1	4	12
May	1	3	0	0	4
Jun	1	2	1	2	6
Jul	0	4	0	6	10
Aug	0	2	0	10	12
Sep	2	2	0	0	4
Oct	0	0	0	0	0
Nov	0	4	2	1	7
Dec	3	7	1	5	16
Total	14	41	14	52	121
Per cent	11½	34	11½	43	100

(See Table 3 for distribution of large rains according to their characteristics.) Table 4 gives a rainfall-runoff summary according to the characteristics of the rains. The soil losses were not given in this table, since so many other factors affected soil losses, and their values showed no relationship to the rainfall characteristics. Rains of less than 0.75 in, classed as 1, 2, and 3, produce little or no runoff, while those in class 4 produce runoff over 50 per cent of the time. Class 1 rains between 0.75 and 1.50 in produce little or no runoff, but class 2, 3, and 4 rains produce runoff in most cases. The runoff from class 2 and 3 rains was small compared to that of class 4. Practically all rains above 1.50 in produce runoff and most

TABLE 4. RAINFALL-RUNOFF SUMMARY FOR EROSION PLOTS, 1939-1944 INCLUSIVE

Rain Class No.	Rainfall No. Rains	Range, in.	Average, in.	Average Duration, hr.	Intensities 10 min in/hr	30 min in/hr	Previous 10-day Rainfall in.	Runoff in.	%	Remarks Runoff from
1	30	0.30-0.47	0.37	5		0.25	0.32	0	0	
2	4	0.40-0.49	0.45	1	1.20	0.80	0.29	0	0	
3	20	0.30-0.48	0.42	6		0.26	2.86	0.012	0.1	2 rains
4	10	0.30-0.45	0.39	1	1.36	0.90	3.80	0.081	20.7	7 rains
1	16	0.50-0.72	0.58	8	0.54	0.29	0.31	0	0	
2	10	0.50-0.72	0.59	2	1.39	0.80	0.28	0.016	2.8	1 rain
3	18	0.50-0.70	0.60	8	0.64	0.32	2.67	0.033	5.5	3 rains
4	14	0.50-0.70	0.61	2	1.64	0.93	2.64	0.119	13.9	7 rains
1	7	0.75-0.99	0.86	9	0.41	0.28	0.31	0.006	0.8	1 rain
2	9	0.75-0.99	0.88	4	1.67	0.94	0.25	0.024	2.7	3 rains
3	7	0.80-0.91	0.86	10	0.46	0.26	3.84	0.108	12.6	7 rains
4	7	0.75-0.95	0.81	2	2.97	1.12	3.03	0.281	34.7	6 rains
1	9	1.00-1.44	1.19	10	0.54	0.35	0.31	0.034	2.9	2 rains
2	17	1.00-1.49	1.24	5	2.23	1.16	0.51	0.164	13.3	17 rains
3	6	1.00-1.31	1.10	10	0.58	0.36	2.39	0.091	8.3	5 rains
4	16	1.00-1.41	1.20	5	2.17	1.15	3.58	0.325	27.1	16 rains
1	2	1.76-1.82	1.79	12	0.75	0.41	0.45	0.248	14.0	2 rains
2	12	1.55-1.80	1.52	5	2.13	1.22	0.37	0.220	14.5	9 rains
4	8	1.50-1.90	1.65	5	2.88	1.39	2.38	0.509	31.0	8 rains
2	12	2.00-6.48	2.97	15	1.93	1.29	0.34	0.794	26.8	12 rains
3	5	2.22-3.75	2.66	15	0.47	0.31	3.05	1.052	39.5	5 rains
4	14	2.00-5.32	3.05	15	2.36	1.31	2.39	1.323	43.2	14 rains

This paper was presented at a meeting of the Southeast Section of the American Society of Agricultural Engineers at Atlanta, Ga., February, 1945.

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[1] Baver, L. D. Rainfall characteristics of Missouri in relation to runoff and erosion. Soil Sci. Soc. Amer. Proc., 2: 533-536, 1937.

[2] Horton, R. E. The role of infiltration in the hydrologic cycle. Trans. 14th annual meeting, Amer. Geol. Union, pp. 446-460, 1933.

of these rains were in classes 2, 3, and 4. That is, the larger rains are more likely to come with high intensities. Also, they are more likely to occur during a rainy period, that is, where there has been considerable rain during the previous 10 days. The data in Table 4 show that nearly two-thirds of the rains of 1.75 in or more are in classes 3 and 4. Table 5 gives the runoff and soil losses for all rains of 1.75 in or more.

TABLE 5. RUNOFF AND SOIL LOSSES FROM RAINS OF 1.75 INCHES OR MORE, 1939-1944

Date	Rainfall, in	Duration, hr	Intensities 10 min, in/hr	Intensities 30 min, in/hr	Previous 10-day Rainfall, in	Class No.	Crop on land	Runoff in	Runoff %	Soil loss, lb/acre
3-2-42	1.76	9	0.42	0.42	0	1	Clover	0.347	20	37
6-29-40	1.82	14	1.08	0.40	0.89	1	Cotton	0.150	8	90
12-12-40	1.76	12	1.92	0.80	0.05	2	Clover	0.330	19	501
8-20-44	1.75	2	5.40	2.12	0.41	2	Cotton	0.310	18	924
1-14-40	1.75	9	1.80	0.80	3.34	4	Clover	,1.050	60	2,421
4-26-44	1.84	3	4.80	2.80	7.11	4	Clover	1.590	85	25
7-20-43	1.90	3	2.40	1.50	1.68	4	Cotton	0.273	14	206
4-9-42	2.00	6	1.20	0.80	0	2	Clover	0.080	4	58
1-17-43	2.15	30	1.20	0.50	0.88	2	Clover	0.558	26	107
12-25-43	2.23	12	0.84	0.64	0.10	2	Clover	0.493	22	24
9-10-44	2.26	16	0.60	0.60	0.72	2	Cotton	0.323	14	43
3-7-41	2.34	6	2.04	1.00	0.08	2	Clover	0.772	33	2,495
7-30-44	2.37	4	5.40	4.00	0	2	Cotton	0.501	21	466
5-11-43	2.53	4	4.20	2.80	0.77	2	Cotton	0.676	27	307
1-12-40	2.75	16	1.44	0.60	0.65	2	Clover	0.940	34	1,406
3-20-42	3.65	23	1.86	1.24	0.44	2	Clover	1.820	50	2,424
12-23-41	6.48	24	1.00	0.60	0.72	2	Clover	2.585	40	2,022
4-25-44	2.22	12	8.72	0.46	4.89	3	Clover	1.148	52	124
3-16-43	2.30	15	0.42	0.25	2.70	3	Clover	0.500	22	24
1-2-44	2.35	9	0.42	0.30	2.55	3	Clover	0.662	28	76
2-26-39	2.66	15	0.43	0.24	3.36	3	Vetch	0.750	28	1,418
3-29-39	3.75	12	0.36	0.32	1.76	3	Clover	2.220	59	4,103
8-14-41	2.00	4	1.86	0.92	1.75	4	Cotton	0.281	14	732
12-25-41	2.06	5	2.88	1.52	6.48	4	Clover	1.140	56	796
8-26-44	2.20	1	5.40	3.20	3.25	4	Cotton	1.225	56	5,563
7-4-40	2.35	9	1.08	0.70	2.89	4	Cotton	0.790	34	947
12-5-42	2.41	7	3.30	1.80	1.34	4	Clover	0.899	37	446
3-5-43	2.44	12	0.85	0.65	1.65	4	Clover	1.010	41	53
6-16-40	2.50	5	1.80	0.84	1.17	4	Cotton	0.500	20	2,310
12-27-42	2.68	25	1.50	1.00	1.21	4	Clover	1.370	51	395
3-18-43	2.78	4	4.20	3.00	2.50	4	Clover	2.110	76	119
6-12-42	2.85	5	3.24	1.60	1.03	4	Cotton	0.870	31	4,791
4-18-44	3.00	8	2.40	1.60	1.96	4	Clover	1.308	44	121
3-22-44	4.92	21	2.22	1.24	2.41	4	Clover	2.938	60	331
3-20-43	5.32	32	1.20	0.70	5.34	4	Clover	2,570	48	52
8-16-39	5.20	74	1.00	0.60	1.54	4	Cotton	1.500	29	2,753

The soil moisture condition cannot be determined accurately by knowing the previous precipitation. The season of the year, the amount of vegetation on the land, the soil type, and wind conditions will greatly affect the soil moisture immediately after rains. Consequently the soil moisture is likely to be lower during the summer months than during the winter months for a given amount of rain in the previous 10 days. Therefore, the runoff from summer rains is usually lower than that from winter rains when the tabulated characteristics appear to be the same. As a general rule, if two rains of approximately the same magnitude have the same general characteristics, they will produce about the same amount of runoff. The watershed characteristics lose their influence on runoff for heavy rains falling on wet soil.

Soil Losses. Watershed characteristics play a much larger role in affecting soil losses, as is shown in Table 5. During the early winter when the vegetative cover is light, there is a heavy soil loss even for a moderate amount of runoff. During the late winter when winter cover crops have made a substantial growth, the soil loss is small even for an excessive amount of runoff. During the period of seedbed preparation and planting, the soil loss is highest in proportion to the runoff. After the first of July, cotton makes a fair canopy cover even though it is a clean cultivated crop. The large leaves intercept and absorb the impact of the raindrops and allow the precipitation to reach the soil gently. However, cotton does not equal a close-growing crop in protecting the soil.

Adjusting Farming Practices. The results of these experiments, as given in Table 5, show conclusively that erosion can be controlled by adequate vegetative cover. The large soil losses occur when the bare soil is exposed to heavy rains during seedbed preparation and seeding and when row-crop cultivation is practiced during the vulnerable seasons. If erosion losses are to be reduced to a minimum, the seedbed preparation should be made after the period of heavy rainfall. For example, in the vicinity of Auburn, no plowing should be done before the first of April. On the steep slopes, it would be a good idea to delay plowing even to a later date.

Cropping practices have been developed at Auburn that will greatly reduce the amount of erosion. These include small grain or winter legumes grown during the winter and grain sorghum or summer legumes grown during the summer. A number of winter legumes, such as Caley peas and bur clover, reseed themselves provided the ground is disked lightly and not plowed. These crops can be pastured until about the middle of April and then allowed to make seed. The ground may then be prepared and planted to grain sorghum or summer legumes about the middle of June. Alyceclover is a new summer legume which promises to be a good crop for seed or hay, as well as for erosion control.

When dwarf type grain sorghum is planted in drilled rows, preferably 15 to 22-in spacing, it provides sufficient cover to protect the soil from heavy rains. The crop can be harvested with a combine. The yields from a one-year test on rows spaced 7 to 22 in, ranged from 18 to 43 bu of grain per acre. If the crop residue is left on the surface, it makes an excellent mulch for erosion control and provides protection to winter crops. As soon as the grain sorghum is harvested in the fall, winter legumes or small grain can be seeded for additional erosion protection and for pasture during the winter. By following a rotation, including a winter legume, followed by grain sorghum, then by oats followed by summer legume, there could be developed a cropping system that would fit into a livestock program and at the same time control erosion.

Killing Mosquitoes with DDT

(Continued from page 462)

tures, as perhaps in very large barns, where combustible material must be absent, or in large military barracks, is it believed the internal-combustion-engine unit as described above may be used with any degree of efficiency.

Use of Large Paint Container. There may be occasions where necessity dictates the use of a paint container for building spraying. As previously discussed this apparatus is heavy and awkward to use, especially when it is necessary to pump air by means of an internal-combustion engine.

In order to avoid use of the engine, the following method was successfully tried out. The liquid hose was connected in the normal manner to the liquid line of the tank. But, instead of attaching the normal paint gun to the air and liquid line, the air line was closed off entirely, and an ordinary whirl spray was connected with the liquid hose. Pressure was pumped into the paint container up to about 2½ atm (35 lb per sq in) by means of the small air pump already described in this paper. *(Continued on page 468)*

Methodology for Soil Tenacity and Soil Erosion Studies

By D. G. Vilensky

Translated from the Russian by D. B. Krimgold, Member A.S.A.E.

SOIL erosion control and especially the combating of sheet erosion is no doubt one of numerous applications of the teachings of Academician W. R. Williams.

The processes of sheet erosion depend on the combined action of a large number of factors among the most important of which are the properties of the soil being subjected to erosion. Unfortunately, the question as to the properties which determine the degree of resistance or the degree of susceptibility of soil to erosion and the best methods of studying these properties have not yet been sufficiently worked out. There are at the present time three main methods of study of these phenomena:

1 Direct study of sheet erosion under natural conditions on plots of various sizes and on soil monoliths.

2 The study of certain physical-chemical properties of soils with a view to determining the correlation between these properties and the resistance of soil to erosion.

3 The direct study both under field and laboratory conditions of the tenacity of soils by means of methods specially developed for this purpose.

The first method found application in the United States. In the USSR the plot and monolith method is being employed on the erosion stations of the Transcaucasian Scientific Research Institute of Water Economy at the Kviriksk Tea Sovchoz in the vicinity of Kobulet[1]*. Undoubtedly, this method is very valuable in determining the relation of steepness of slope, exposure, intensity of precipitation, methods of tillage, and the influence of natural and cultural vegetation and other factors. It is also valuable for quantitative measurements of erosion. However, due to geographic limitations this method cannot be employed in determining the characteristics of soils of large areas as is necessary in connection with mapping of erosion.

The second method attempts to solve this problem by endeavoring to establish the correlation between certain basic physical and physical-chemical properties of soils and their susceptibility to erosion. This method is also being developed primarily in the United States where a wide literature is devoted to this subject[2,3,4,5]. It is hardly necessary to prove the importance of studying these physical and physical-chemical properties in order to facilitate the determination of the properties of soil in relation to erosion. The attempt to determine the relation between the above-mentioned soil properties and erosion and the attempt to represent this relation in terms of simple expressions of the type of "erosion ratio", "dispersion ratio", and others merit considerable attention. Nevertheless the very character of these expressions clearly show that we are dealing here with the first attempts to find not so much a quantitative as a qualitative relation between these phenomena. In order to determine the feasibility and advisability of a wide application of these expressions for the determination of the characteristics of soils in a given region, it is necessary first of all to check how nearly the quantities given in these expressions coincide with results of direct studies of erosion under natural conditions.

In connection with the above, the third method of studying the erosion properties of soils, i. e., the direct investigation of tenacity, by means of adequate field and laboratory methods is especially interesting. It is to be regretted that until the present time this method has not been developed either in the United States or in the USSR. Studies of the phenomena of slacking and washing of soils are at the present time primarily the concern of highway engineers. To a lesser degree this question is dealt with by specialists in the field of ceramics. To a still lesser degree has it been the concern of soil scientists.

Having been given an assignment by the All-Union Scientific Research Institute of the Humid Subtropics and by the Transcaucasian Scientific Research Institute of Water Economy to work out the properties of soils most intimately related to erosion and to develop methods of laboratory investigations of these properties, we have naturally directed our work primarily toward the direct determinations of the tenacity of soils. The tenacity of soils as a whole depends on one hand on the tenacity of the component parts of the soil, i. e., of its aggregates, and on the other hand on the cohesion between the aggregates, i. e., on the firmness of the structures of the soil. Our work was directed toward the testing of existing methods of studying individual aggregates and of the soil structure as a whole and toward the development of new methods. As a result of the conducted tests, existing methods have been modified and new methods partially developed. After completing the laboratory work we conducted field tests on the erosion stations of the Transcaucasian Scientific Research Institute of Water Economy and of the All-Union Scientific Research Institute of the Humid Subtropics in the vicinity of Batum. In the main our work consisted of the study of slacking and washing of the individual aggregates and of entire soil samples.

The soil samples were artificially prepared and were also taken under field conditions with an undisturbed structure. The work was conducted in accordance with the following methodology:

1 *Structural Analyses of the Soil.* This analyses represents the first step in the work on aggregates and precedes all the others. It was conducted in the usual manner by

TRANSLATOR'S NOTE: This paper, a contribution of the Section of Genesis and Geography of Soils, Scientific Research Institute of Pedology, Moscow State University, was translated about ten years ago at the request of Dr. H. E. Middleton of the U. S. Soil Conservation Service. Recent work reported by McCalla and by Ellison and Slater ("Water-drop Method of Determining Stability of Soil Structure" by T. M. McCalla, Soil Science, vol. 58, no. 2, pp 117-121, and "Factors That Affect Surface Sealing and Infiltration of Exposed Soil Surfaces" by W. D. Ellison and C. S. Slater, AGRICULTURAL ENGINEERING, April, 1935, pp 156-157) indicates a current interest in this subject. The thought that other workers may wish to continue such studies and to verify the results reported thus far prompted me to make available Professor Vilensky's paper on the methodology developed by him and his associates. Professor Vilensky is listed as a member of the organization committee of the Soil Science Society of the Union of Socialist Soviet Republics which includes Professors Hemmerling, Katchinski, and others. It should be pointed out that subsequent to the publication of Vilensky's paper a comprehensive research program was carried out by the Experimental Institute of Hydrotechnics and Melioration of the USSR Lenin Akademy of Agricultural Sciences and affiliated agencies in various parts of the USSR. Volume III of "Dozhdevanie", published by this institute in 1940, contains several papers reporting, among other, results of field and laboratory studies on the effect of artificial and natural rainfall on the structure of various soils.

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*Superscript numbers refer to appended references.

means of segregating a given weight of air-dry soil on sieves with openings of 15, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1, and 0.5 mm, i. e., at intervals of about 1 mm. The dry weight of the fractions thus obtained was determined. The most abundant fractions, in the range of from 1 to 10 mm were used in the investigations. In the field the aggregates were investigated also under conditions of field moisture.

2 *Determination of Volume of Aggregates.* In connection with work on aggregates it is important to know their volume (when selecting aggregates homogeneous with respect to volume) and to determine their specific gravity and porosity. It is, therefore, essential to be able to make rapid and numerous determinations of the volume of aggregates.

The volumeter shown in Fig. 1 was employed for this purpose. (The apparatus described here was constructed by the glass blower, I. Eremenko, and by the mechanic, E. Morozov, with the close collaboration of B. V. Tolstopicatov, research associate of the N.I.I.P. and N.G.U.) The apparatus consists of two glass cylinders (1 and 5 of Fig. 1) covered with glass stoppers 2 and 4 and connected by means of a glass tube 3 graduated in 0.01 cc. One of the cylinders and the corresponding length of the tube are filled with mercury up to the stopper and the reading on the tube is recorded. By tilting the apparatus, part of the mercury in the cylinder is transferred into the tube. One or several aggregates of known weight are placed in the cylinder. The mercury is then brought back into the cylinder up to the stopper and a new reading is taken. When the cylinder is being filled with mercury, the air escapes through a hole in the stopper. Two types of stoppers are employed. In one, the air escapes through a sieve placed at the base of the stopper (6 in Fig. 1). In the other, a very thin capillary tube (7 in Fig. 1) which can be closed with a stopcock is used. At the end of the determination the mercury is transferred into the other cylinder and the aggregates are taken out. Ordinarily the volume of from 25 to 50 aggregates can thus be determined.

3 *The Determination of the Degree of Slacking of Aggregates.* This determination involves two operations: the soaking of the aggregates and the analysis after slacking. Ten grams of aggregates are placed on the bottom of a glass container (8 cm deep and 5 cm in diameter) with two tubes (Fig. 2). Water is supplied to the container through the lower tube in sufficient quantity to wet the bottom of the container and to saturate the aggregates through capillary action. This saturation takes place in the course of 30 min. After that more water is introduced through the lower tube until it reaches the lower edge of the upper tube and the aggregate is subjected to slacking for one hour. The analyses of aggregates of less than 0.25 mm is then made on sieves of from 0.25 to 0.01 mm by Kopetsky's method; the analyses of aggregates of less than 0.01 mm is made by the pipet method (Robinson). It is desirable to eliminate the use of sieves and to replace them by a special apparatus which will make it possible to carry out the entire operation of the fractioning in water without shaking and mechanically disturbing the aggregates. Besides the slacking in water, it is of great interest to determine the degree of slacking of aggregates in various solutions (salt, acid, and alkaline solutions). It is also interesting to study the slacking of aggregates in a slow stream of water or solution.

4 *Determination of the Stability of Aggregates When Subjected to Washing with Drops of Water.* For this purpose an apparatus which enables the determination of the rate of washing of the aggregates by drops of water falling from a burette is employed. It consists of a Mariotte vessel (6 in Fig. 3) and of a horizontal tube with six taps, as shown by 1, 2, and 3 of Fig. 3. The water from the Mariotte's vessel drips through the small holes of the taps. The rate at which the water comes through is regulated by means of cocks 2. Cock 3 is used to cut off the flow. The rate of flow was set at 2 drops per second, the volume of the individual drops being 0.03 cc. The aggregates under investigation are placed 5 cm below each of the taps in

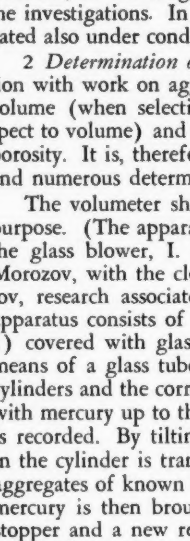

Fig I

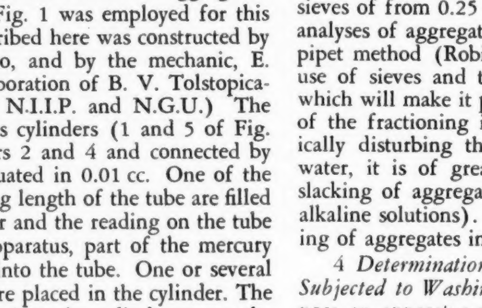

Fig. 3

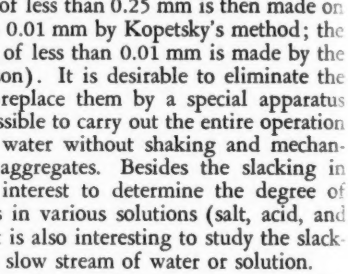

Fig. 5

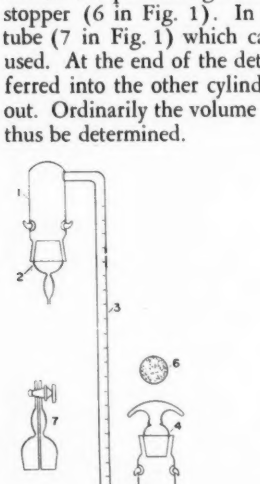

Fig 2

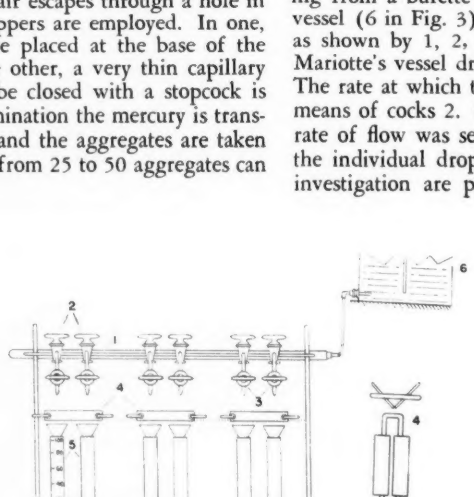

Fig 4

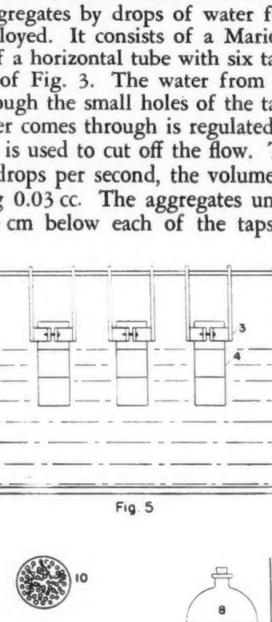

Fig 6

special glass containers consisting of two plates placed at an angle of 90 deg with a slot of 1 mm through the middle (4 of Fig. 3). After the apparatus is assembled 50 aggregates of given dimensions, the weight of which is previously determined, are subjected to washing by the falling drops of water. The water passing through the slots in the containers is collected in five 100-cc graduates. The stability of each aggregate is determined by the amount of water used in washing it through the slot. The 50 aggregates subjected to this process are analyzed with respect to the degree of resistance of aggregates of a given size and also with respect to the uniformity in the tenacity of the aggregates.

5 *Determination of the Rate of Slacking of Soil Samples.* The determination of the rate of slacking of soil samples rather than of individual aggregates was originally carried out in accordance with M. E. Volkov's method[7]. In the course of the tests a number of defects in this method compelled us to make changes resulting in the following procedure: A cylindrical sample 3.5 x 6 cm in size is either cut out by means of the auger shown in 1 of Fig. 4 or a sample of the same dimension is prepared artificially from soil passed through a 1-mm sieve and mixed so as to have a predetermined moisture content. It is common practice to use 200 g of soil. The soil is thoroughly mixed with the required amount of water supplied from a burette and is placed in a steel cylinder 3.5 cm in diameter consisting of two halves as shown in 5 of Fig. 4. They are placed in a steel cylinder having several screws on its sides as shown in 4 of Fig. 5. By tightening these screws the two halves of the inner cylinder are pressed firmly together. Depending on the problem at hand the soil in the cylinder is then either tamped or slightly compressed by means of a wooden pestle shown in 2 on Fig. 4. The screws of the outside cylinder are then loosened, the inner cylinder is carefully taken out, and the two halves of the steel cylinder are removed. The soil samples prepared in this manner or samples cut from the soil with the auger are air-dried and are then subjected to testing. The samples obtained from the natural soil can also be tested under the conditions of field moisture immediately after they are taken. Before testing either of these samples, the upper and lower two centimeters of the soil cylinders are carefully coated with paraffin by dipping and only the middle two centimeters are left free. The cylinders are placed in metal collars (3 of Fig. 5) and are hung on a rod (1 of Fig. 5) placed over a glass container partly filled with water (Fig. 5). Ordinarily three such cylinders are placed in the glass container and sufficient water is added so that it covers all of the uncoated portion of the cylinder. The rate of slacking is then determined by means of a stop watch. The time it takes for the lower part of the cylinder to drop off into the container is taken at the time of slacking.

6 *Determination of Surface Washing of Soil Samples.* This determination was also originally conducted in accordance with Volkov's method described in the above cited work. This method, however, did not satisfy us and it was necessary to modify it. The work was done on cylindrical samples 3 cm high and 10 cm in diameter. The natural soil samples were obtained by means of the auger shown in 6 and 7 of Fig. 4. Artificial samples were prepared as in the former case with the aid of the steel cylindrical form of the auger (6 of Fig. 4). The artificial samples thus obtained and samples cut out of the soil in the field were air-dried until they reached a constant weight. The field samples were also subjected to testing under conditions of field moisture. The tests were made with the aid of the apparatus shown in Fig. 6. It consists of a sieve rainmaker (2) which can be clamped at the desired height on a standard, and of a round table 10 cm in diameter. This table is rotated by means of a spring mechanism (7) at the rate of one revolution per minute. The diameter of the sieve is 10 cm and the height of the rim is 5 cm. The bottom of the sieve consists of 50 conical nozzles each with a base diameter of 1 cm and an orifice diameter of 0.5 mm (10 and 2 in Fig. 6). The sieve is covered with a lid having two holes. Through the smaller one is inserted the tube (9) which connects the sieve with the water supply. The glass tube (1) is inserted in the larger hole and serves to indicate the water level above the nozzles. The sieve is clamped on the standard so that the nozzles are 5 cm above the sample and so that with a height of water of 12 cm in the glass tube, a uniform fine rain with a total discharge of one liter per minute is produced.

A round piece of oilcloth 10 cm in diameter is then placed on the table and the soil sample is placed on top of it. The table is rotated at the rate of one revolution per minute by means of the spring mechanism. The sample is subjected to washing for 15 min. This washing is being done over a metal or glass container into which are placed a set of sieves so that, if necessary, aggregate analyses of the material obtained through washing can be made.

The part of the sample remaining on the oilcloth at the end of the 15-min period is removed and its dry weight is determined. The loss in weight is a measure of the degree of resistance to washing. Ordinarily three tests are made and the average of the determinations is used. The results of the tests can be expressed in terms of per cent of the original sample washed away or as the amount of soil washed out in a unit of time. In cases where the entire sample is washed away in less than 15 min, the time in which washing took place is recorded. Along with the quantitative determinations in all these tests, a wealth of information on the behavior of the soil during slacking and washing is obtained by observing the process and the form which the sample takes.

Without entering into a discussion of the erosion characteristics of the soils which were investigated by the above-described methods in the laboratory and in the field, we wish to state that experience with this methodology both under field and laboratory conditions indicates the possibility of obtaining the erosional characteristics of soil; these characteristics were shown to be quite close to those which were obtained by means of time-consuming determinations of the solid runoff from monoliths. We feel that direct investigation of soil tenacity may constitute important means of speedily determining general characteristics of soils for mapping purposes as well as of arriving at the nature of the properties which determine the resistance or susceptibility of soils to erosion.

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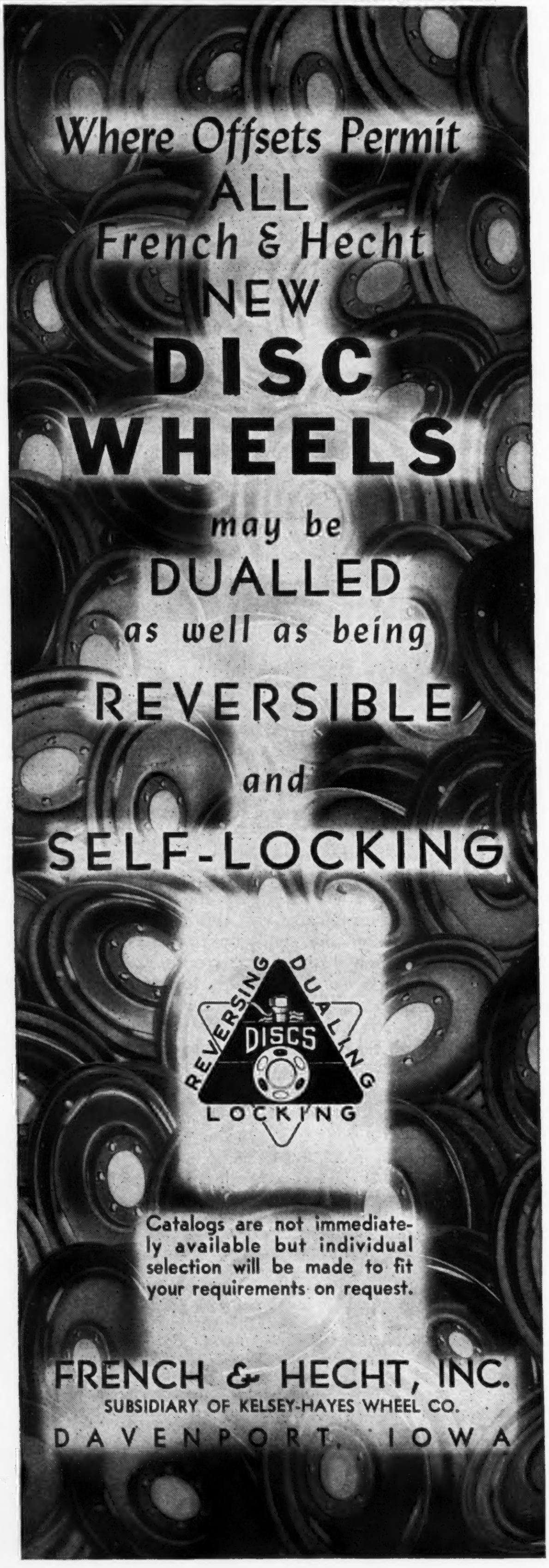

"Remember the Reichsbanknote"

To the Editor:

I WISH to object strenuously to the publication of unsigned personal opinions as editorials in our society journal, Agricultural Engineering, as in the October issue under the above title.

In the first place, the arithmetic is wrong because, even if labor got a 30 per cent raise, labor costs do not represent 100 per cent of the retail sales price. Only *part* of the manufacturing cost goes up with wages. Also shipping, storage, and selling costs (which often exceed manufacturing cost) need not be affected at all by change in manufacturing cost, except for the small boost in insurance and carrying charges. I admit these other services eventually may have to pay higher wages, but again a large part of distribution costs is in capital plant: railroads, warehouses, etc., for which interest rates are now low.

In the second place, it is virtually impossible to decree lower prices. The U. S. has done better in keeping prices down in this war than the last, and there is no runaway printing of money to pay government expense in place of taxation, as was the policy in Germany.

In the third place, the collapse of German currency did not ruin German agriculture nor industry. The real values remained intact (as their war potential proved). Land prices here are up well over 30 per cent. And some people are willing that our terrifying national debt be scaled down at the expense of bondholders.

In the fourth place, prosperity involves rate-of-circulation, and "labor" that now demands the 30 per cent raise spends every nickel promptly.

Let's stick to our own problems in editorials. Farmers are better able now to buy equipment than ever before. Can't you find someone to show us how much the 40 per cent agricultural wage boost (relative to 1941) now affects the price of farm products?

What I think most critical is the handling of abundant production in an economy based on scarcity. What will happen in another depression when every adult knows we destroy food, and fail to produce more goods and better living than any other country, simply because there is no war to make the wheels run?

F. A. Brooks

Killing Mosquitoes with DDT

(Continued from page 464)

This pressure was about the maximum the small pump unit would develop, but it was adequate for operating the whirl spray. Since only liquid was discharged by the whirl spray, very little labor was required to keep the contents of the tank under the desired pressure.

The distinct advantage of this system lies in the fact that the pressure on the nozzle remained almost constant. This permitted a uniform distribution of spray.

Another advantage was that two hose lines are eliminated—an important factor when the time element is considered.

SUMMARY

This report describes improvements in types of equipment which may be used to spread DDT as a mosquito-control measure. The use of DDT as a mist spray is discussed. Improvement in mechanical distribution for larviciding purposes and development of techniques of application to secure maximum residual effect against adult mosquitoes are reviewed.

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NEWS SECTION

A.S.A.E. Fall Meeting Program

THE one-day fall meeting of the American Society of Agricultural Engineers to be held in the Tower Ballroom of the Stevens Hotel, Chicago, Friday, December 7, will have as its general theme: "A Preview of New Agricultural Engineering Horizons." The meeting will be opened by an address by Society President, J. Dewey Long, director of education and market research, Douglas Fir Plywood Association. The remainder of the program has been arranged so the Society's five divisions will each have a one-hour period in which to highlight subjects or problems of particular interest or urgency upon which special attention needs now to be focused. Each period will be opened with a brief keynote talk, following which a panel of Society members especially selected will answer questions sent in to the Society's headquarters or to the division chairman before the date of the meeting, as well as questions submitted from the floor during the meeting.

The rural electrification part of the program will be opened by a talk by H. J. Gallagher, farm service supervisor, Consumers Power Company, the subject of which will be "Engineering Farm Chore Jobs." In addition to Mr. Gallagher the rural electrification panel will include P. T. Montfort, A. & M. College of Texas; C. P. Wagner, Northern States Power Co., A. H. Hemker, General Electric Co.; D. G. Womeldorff, Public Service Co. of Northern Illinois; F. W. Duffee, University of Wisconsin, and W. D. Hemker, Westinghouse Electric Corp.

The farm structures period of the program will be opened with a talk, entitled "Buildings That Meet Farm Housing and Storage Needs", by Deane G. Carter, professor of farm structures, University of Illinois. The question panel on farm structures will include, in addition to Mr. Carter, H. J. Barre, Purdue University; Henry Giese, Iowa State College; Wallace Ashby, Division of Farm Structures and Rural Housing, BPISAE, USDA; R. A. Glaze, Weyerhaeuser Sales Co.; E. L. Hansen, Portland Cement Association; and J. L. Strahan, Flintcote Company.

The afternoon session will open with a short special business meeting of the Society, following which a one-hour period will be devoted to the interests of soil and water conservation, with Dr. M. L. Nichols, chief of research, Soil Conservation Service, USDA, opening the period with a talk, entitled "Saving the Good Earth—An Engineering Challenge." The soil and water panel will include, in addition to Dr. Nichols, Howard Matson, Soil Conservation Service; I. D. Wood, Soil Conservation Service; D. A. Milligan, Harry Ferguson, Inc.; P. W. Manson, University of Minnesota, and I. D. Mayer, Purdue University (or R. B. Hickok, Soil Conservation Service).

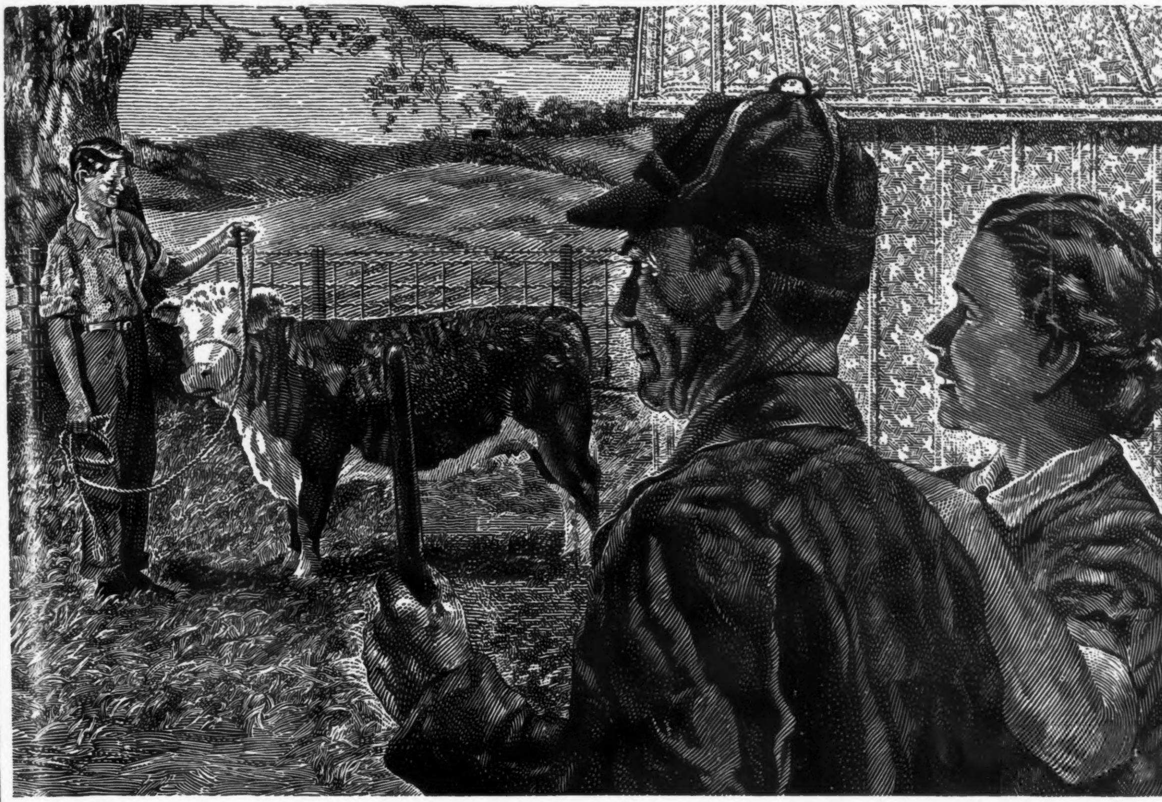
The second period of the afternoon session will be devoted to the subject of farm power and machinery, with C. E. Frudden, consulting engineer, tractor division, Allis-Chalmers Manufacturing Co., giving the keynote talk, entitled "The Outlook for Farm Mechanization." For the question period, Mr. Frudden will be supported by a panel of specialists in this field consisting of R. B. Gray, Power and Machinery Division, BPISAE, USDA; Theo. Brown, Deere & Company; D. C. Heitshu, Harry Ferguson, Inc.; C. B. Richey, Electric Wheel Co.; A. P. Yerkes, International Harvester Co., and Dr. J. B. Davidson, Iowa State College.

The final one-hour period of the program will be devoted to the interests of members of the College Division of the Society, with George B. Nutt, chairman of the Division, and head of the agricultural engineering department, Clemson Agricultural College, leading off with a talk, entitled "Training Agricultural Engineers To Meet Today's Challenge." The panel for the question period will include, in addition to Mr. Nutt, F. C. Fenton, Kansas State College; R. H. Driftmier, University of Georgia; A. J. Schwantes, University of Minnesota; A. B. Skromme, Firestone Tire and Rubber Co.; A. W. Farrall, Michigan State College, and A. R. Schwantes, Insulite Div., M. & O. Paper Co.

It is believed that, with the talks by the keynoters for each divisional group followed by answers of specialists in each field to questions presented, that the meeting will perform a real service in "pointing up" both the opportunities and challenges lying ahead for agricultural engineers. Friends as well as members of the Society are welcome to submit questions to the various panels both before and during the meeting, but it is especially desired that as many such questions as possible be sent in to Society headquarters, St. Joseph, Michigan, before the meeting in order that members of the panels may give some thought in advance to the preparation of appropriate answers.

The Stevens Hotel is anticipating a need for one hundred guest rooms in connection with this meeting, and urges that all who desire guest room reservations in connection with the meeting place their reservations not less than two weeks before the meeting date.

(Continued on page 472)



"Now, son, you're in business for yourself"

That heifer is yours. From now on, your Mother and I expect you to take care of her—to raise her right. You're in business for yourself—your dreams of your future can begin to be realized through the herd you're starting today.

Any profit your calf will bring will be yours. That means that you're a capitalist, just as truly as though you had a safe deposit box full of stocks and bonds.

You'll find most of this country's capitalists in overalls, Bill, rather than in silk hats.

That's because every American—whether he's a farmer, a merchant, a wage earner, a manufacturer, or anyone else—has the opportunity to invest his time, his work, or his money—to make more money. That makes most of us capitalists, in the real meaning of the word.

Maybe we start out in a mighty small way—like you with one calf of your own, or my Dad with a few acres of woodlot and pasture—but we have a wide-open chance to get ahead.

The big point is that the opportunity is always here. It has been that way since this country began. That, more than anything else, is what has created progress, prosperity, happiness and self-respect beyond what any other nation has ever known.

Other countries have the natural resources that we have—everything except that glowing spark of free opportunity. Yet you'll find people, Bill, who'll try to tell you that things would be better if we'd let somebody else do our thinking and planning for us.

The catch is that in order to try out most of these fancy theories and plans, we'd have to give up our heritage of individual freedom—in return for glittering promises.

Look what happened to the people of Germany and Italy. They listened to promises—and lost both their freedom and their promised security.

To give up that freedom is too high a price to pay for any regimented security. The best security, son, is the security of free opportunity. That's our birthright as free Americans, and we must keep it.

WELCOME BACK—TIN CONTAINERS!

During the war, tin cans served in many ways—as containers for food, blood plasma, bomb fuses, concentrated food tablets, fishing tackle, and rations of all kinds. Ask any returning veteran.

Soon housewives will welcome them back to peacetime duties. Back to their job of providing safe, convenient containers for familiar items—baby food, dog food, fruit, fish, meat, beer, and other foods and beverages, as well as oil for automobiles and paint for homes.

The tin can is really a steel can with a tin coating—more than 98% steel and less than 2% tin. Republic Steel is an important producer of tin plate under the most modern production method—electrolytic tin plating—a method which "flows" tin evenly over the steel plate, forming a more uniform coating, at the same time saving tin.

Tomorrow, many more products in tin will contribute to America's comfort and pleasure.

BUY VICTORY BONDS... BRING THE BOYS HOME

The Army-Navy E flag waves over 8 Republic plants and the Maritime M floats over the Cleveland District plant.

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WOVEN WIRE FENCING • BARBED WIRE • STEEL FENCE POSTS
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and STAINLESS STEELS for FARM and DAIRY EQUIPMENT

NEWS SECTION

(Continued from page 470)

Special attention also is called, in connection with this meeting, to a meeting of the Chicago Section of the Society during the evening of the same day at the Builders' Club, 228 North La Salle, Chicago. This will be a dinner meeting, and reservations for the dinner should be sent to Section Secretary Hugh C. Smith, The Sisalcraft Company, 205 West Wacker Drive, Chicago 5, who will accept reservations up to the maximum seating capacity of 180 persons. The subject of the program for the evening will be "Engineering Chore Jobs on the Farm", and A.S.A.E. members outside the Chicago area, who will be attending the Society's fall meeting that day, are extended a special invitation to attend also the Section's dinner meeting in the evening.

A.S.A.E. Barn Hay Curing Conference

THE previously announced conference on barn curing of hay, to be sponsored by the American Society of Agricultural Engineers, will be held January 7, 8 and 9, 1946, in the Memorial Union, Purdue University, Lafayette, Indiana. The program for the conference is being arranged by the Society's Committee on Hay Harvesting and Storage, and suggestions as to speakers and topics for the program should be addressed to the chairman of the Committee, C. B. Richey, Electric Wheel Company, Quincy, Ill.

Requests for guest room reservations in connection with this conference should be addressed to H. J. Barre, head, agricultural engineering department, Purdue University.

Invitation to Ag Engineers

A MEETING of the Farm Fire Protection Committee of the National Fire Protection Association is scheduled to be held at the Blackstone Hotel, Chicago, Wednesday, December 5, and a special invitation is extended to members of the American Society of Agricultural Engineers, who may be in Chicago at the time and who are especially interested in farm fire protection work, to attend the meeting.

Long at Construction Conference

J. DEWEY LONG, president, American Society of Agricultural Engineers, represented the Society at the building construction conference held in Washington, D. C., on November 1, under the sponsorship of the Construction Industry Advisory Council of the Chamber of Commerce of the U.S.A.. He reports that the chief accomplishments of the conference were the agreement of all speakers and representatives that the construction industry must not permit inflation of housing costs, and on the Snyder (OWMR) statement that further price controls were not contemplated and that those now in effect would be made more workable. President Long's contribution to the conference was in the form of a statement on a proposed program for farm construction published elsewhere in this issue.

Newton Heads Pennsylvania Section

PAUL J. NEWTON, treasurer and general manager, Hertzler & Zook Co., Belleville, Pa., was elected chairman of the Pennsylvania Section of the American Society of Agricultural Engineers at a meeting of the Section held in the Agricultural Engineering Building at Pennsylvania State College, October 22 and 23. He succeeds R. A. Knight, division manager, Pennsylvania Power Co., who has the distinction of being the first chairman of the Pennsylvania Section organized in 1944. C. A. McDade, owner, C. A. McDade Co., Pittsburgh, was elected vice-chairman, and E. W. Schroeder, agricultural engineer, Pennsylvania State College, was re-elected secretary-treasurer of the section. The Section's new nominating committee consists of J. B. Stere, G. G. Connor, and R. J. McCall.

Sixty-eight members and friends of A.S.A.E. attended the section meeting at which a very interesting program was presented.

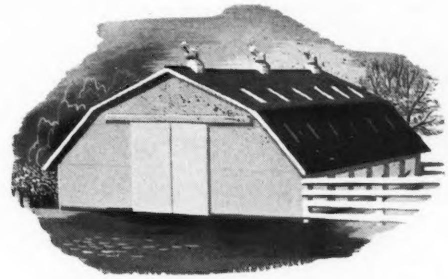
News from USDA

IN order to implement the increasing activity of the Division of Mechanical Processing of Farm Products of the USDA Bureau of Plant Industry, Soils and Agricultural Engineering, the following assignment changes have been announced by Arthur W. Turner, assistant chief of the Bureau in charge of its agricultural engineering divisions:

Wilbur M. Hurst, senior agricultural engineer, formerly in charge of the cooperative flax processing project at Corvallis, Ore., has been transferred to Washington, D. C., to initiate a new project which is planned to cover the develop- *(Continued on page 474)*

for permanence, economy, fire safety–

specify Johns-Manville Asbestos Flexboard

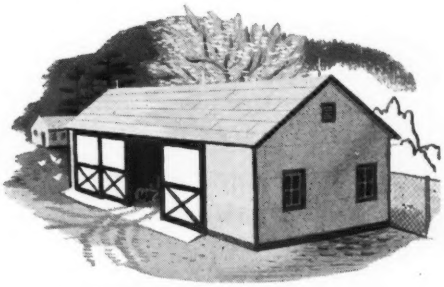


Hog Houses—Flexboard on the exterior walls makes a low-cost, weather-tight building.

Dairy Barns—Inside or out, Flexboard saves money because it needs no painting or whitewash and is easy to keep sanitary.

Quick facts about Flexboard—Made of asbestos and cement, Flexboard is hydraulically pressed and then repressed for extra strength. It has the permanence of stone, yet is inexpensive and easy to work. Comes in large 4′ x 8′ sheets. Has a hard smooth surface that's easy to clean, needs no paint or whitewash. Flexboard is fireproof, rotproof, moisture-proof, rodent-proof. Can be used inside or out for walls, roofs, floors or ceilings on new or remodeled structures.

A free research service—Johns-Manville maintains one of the most complete research laboratories in the world on Building Materials. If you have a special farm building or research problem, write to the farm division about it. J-M will gladly work with you to the extent of its facilities.



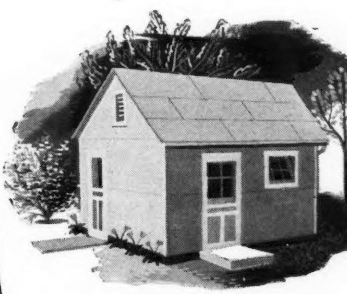
Machine Sheds—Flexboard walls and roof provide quick, low cost, yet permanent construction.

Are your files up-to-date?

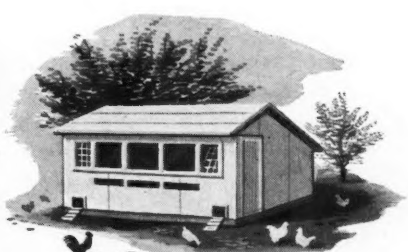
Have you got the following Johns-Manville printed material?

1. Farm Idea Book
2. Agricultural Handbook
3. Maintenance & Repair Manual
4. Farm Building Plan Service
5. Low-Cost Farm Structures

Indicate the material you want and write to Johns-Manville, Department AE, 22 E. 40th St., New York 16, New York.



Milk Houses—Flexboard is easy to wash down. Helps meet the most rigid health regulations.



Laying Houses—Flexboard helps fight poultry diseases because it's easy to clean, easy to disinfect.

JOHNS-MANVILLE PRODUCTS

Johns-Manville Asbestos Flexboard

NEWS SECTION

(Continued from page 472)

ment of machinery and methods for processing farm products on the farm and in rural enterprises.

Jesse E. Harmond, senior agricultural engineer, from the Cotton Ginning Laboratory at Stoneville, Miss., has replaced Mr. Hurst at Corvallis. During the past eight years, under Mr. Hurst's direction, considerable improvement has been made in the machinery and methods used for harvesting and processing fiber flax so that it is now proposed to put greater emphasis on more fundamental problems affecting this industry.

Charles M. Merkel, agricultural engineer, has recently reported for duty at the Cotton Ginning Laboratory. Mr. Merkel has had considerable experience in the design and construction of cotton ginning machinery and under the direction of Charles A. Bennett, engineer in charge of the Laboratory, will study equipment for cleaning lint cotton.

Ralph Patty Passes

JUST as this issue was ready to go to press, it was learned that Ralph L. Patty, head of the agricultural engineering department at South Dakota State College, passed away November 6th after a brief illness.

Personals of A.S.A.E. Members

W. M. Carleton, formerly instructor in agricultural engineering, and *J. W. Martin,* formerly assistant professor of agricultural engineering, Kansas State College (both temporarily in the USNR) are listed as joint authors of "Sharpening and Hard-Surfacing Plow and Lister Shares," published earlier this year as Bulletin No. 44 of the Kansas Engineering Experiment Station.

M. Hamilton Clark has resigned as district representative of the Caterpillar Tractor Company in Mississippi, to accept the position of general manager of the Taylor Machinery Company at Memphis, Tenn., "Caterpillar" distributors in the Memphis trade area.

E. M. Dieffenbach, until recently connected with the farm machinery and equipment division of War Food Administration, has transferred to the Division of Farm Power and Machinery, Bureau of Plant Industry, Soils and Agricultural Engineering, USDA, at Agricultural Research Center, North Laboratory, Beltsville, Md.

George H. Dunkelberg, who served as a captain in the 321st Glider FA Division of the Army and who was held prisoner for several months by the Germans, has been separated from the army and has returned to his former position as associate agricultural engineer with the South Carolina Agricultural Experiment Station at Clemson.

Alfred D. Edgar, agricultural engineer, Bureau of Plant Industry, Soils and Agricultural Engineering, USDA, and *Thomas E. Long,* formerly assistant agricultural engineer, North Dakota Agricultural Experiment Station, and now agricultural engineer with the Republic Steel Corporation, are authors of Circular 72 on ventilating Red River Valley potato storage structures recently issued by the North Dakota station.

F. C. Fenton, head, agricultural engineering department, and *E. L. Barger,* formerly associate professor of agricultural engineering, Kansas State College, are listed as authors of Bulletin No. 45 of the Kansas Engineering Station, entitled "The Cost of Using Farm Machinery," bearing the issue date of April 15, 1945.

John R. Haswell, extension agricultural engineer, Pennsylvania State College, is author of a mimeographed leaflet entitled "Removal of Scale and Deposits in Motor Pipes with Chemicals", and will be glad to send copies to interested agricultural engineers.

Donald M. Kinch has resigned as tractor design engineer for the Oliver Corporation, to accept a position as design engineer with Climax Industries, Clinton, Iowa.

W. E. McCune, H. P. Smith, P. T. Montfort, and *E. S. Holmes* agricultural engineers of the Texas Experiment Station and the department of agricultural engineering, A. & M. College of Texas, are joint authors of progress report 953 issued at College Station, Texas, on August 3, 1945, and entitled "Artificial Drying of Grain Sorghum."

W. E. McCune has resigned his position as agricultural engineer at the Texas Agricultural Experiment Station and has accepted a position with the same title in the commercial department of the Central Power and Light Company, Corpus Christi, Texas.

E. G. McKibben, formerly professor of agricultural engineering, Michigan State College, is listed as author of Article 28-7, from the August 1945, Michigan Agricultural Experiment Station quarterly bulletin, entitled "Sugar Beet Harvester Trials in Michigan in 1943 and 1944." (Continued on page 476)

Personals of A.S.A.E. Members

(Continued from page 474)

Thomas A. H. Miller recently retired as chief of the plan exchange and information section of the Farm Buildings and Rural Housing Division of the Bureau of Plant Industry, Soils, and Agricultural Engineering, USDA, following 37 years in government service, of which 28 years were spent in agricultural engineering work. In his work for the Bureau he was responsible for the farm building plan exchange service rendered by the Bureau in cooperation with state agricultural colleges. Mr. Miller is author of a large number of practical publications including such subjects as the use of concrete on the farm, logs and poles in farm construction, roof coverings, foundations for farm buildings, rammed earth buildings, adobe buildings, functional requirements in designing dairy barns, hot house requirements, and requirements in designing poultry houses. Mr. Miller will spend his retirement at the family farm, Wake Robin, near Widewater, Virginia.

Ernest L. Munter, who has been serving as engineer with the Glenn L. Martin Company during the war, has accepted a position as agricultural engineer on the William Gehring Farm at Rensselaer, Indiana.

W. J. Nemerever is now employed as aerodynamicist in the airplane division of the Curtiss-Wright Corporation at Columbus, Ohio.

Charles E. Peach, until recently assistant project engineer, Lockheed Aircraft Corporation, has entered the employ of the Vitamized Feed Company at Fort Dodge, Iowa, where he will engage in general work for the company including plant operation.

Lee C. Prickett, who served as an electrical engineer in the military intelligence division, Office of Chief of Engineers, USWD, during the war, recently accepted appointment as agricultural engineer, Bonneville Power Administration, at Portland, Ore.

Earle K. Rambo, extension agricultural engineer, Arkansas Agricultural Extension Service, is author of Extension Plan Series No. 7 which describes a homemade lespedeza seed harvester attachment for a mower; he is also joint author of Extension Plan Series No. 3 describing inexpensive methods of storing fruit and vegetables.

E. C. Sauve, professor of agricultural engineering, and *E. G. McKibben,* formerly professor of agricultural engineering, Michigan State College, are listed as authors of article 28-1, from the August, 1945, Michigan Agricultural Experiment Station quarterly bulletin, entitled "Studies on Use of Liquid in Tractor Tires." The article deals with the effect of loss of pressure, change of pressure with temperature, bouncing characteristics, and resistance to damage by impact.

Arthur H. Schultz, who served as a lieutenant in the 351st bomber group of the AAF has returned to civilian status and is now employed as extension agricultural engineer at North Dakota Agricultural College where he will engage in regular agricultural engineering extension.

H. P. Smith, chief, division of agricultural engineering, Texas Agricultural Experiment Station, has the distinction of having his book, entitled "Farm Machinery and Equipment," translated into Spanish. Under the title "Maquinaria Agricola y Accesorios," this book is being published in two volumes by Cultural, S.A., of Havana, Cuba. It is expected that two volumes will have wide distribution in Spanish-speaking countries.

Clyde Walker has resigned as professor of agricultural engineering and recently appointed head of the agricultural engineering department at Oregon State College, to become agricultural director of the R. M. Wade and Co., tractor sales division, Portland, Ore., distributors of agricultural equipment for Oregon, Washington and western Idaho.

Robert G. White has resigned as extension agricultural engineer at Kansas State College to accept the position of supervisor of the Michigan Hydrologic Research Project of the Soil Conservation Service, USDA. He will be located at East Lansing, Michigan.

Homer D. Witzel has resigned as agricultural engineer of The Oliver Corporation to accept a position as agricultural sales engineer for McCune and Company, distributors of specialized farm equipment in five states.

H. A. Wright, who has been connected with the J. I. Case Company's branch at Atlanta, Georgia, for some time has been transferred to that company's branch at Indianapolis, Ind., where he now holds the position of assistant branch manager.

George Yamanaga has resigned as assistant agricultural engineer, U. S. Soil Conservation Service, to accept a position as hydraulic engineer in the surface water division of the U. S. Geological Survey. He is located in Hawaii with headquarters at Honolulu.

Applicants for Membership

The following is a list of recent applicants for membership in the American Society of Agricultural Engineers. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

Charles A. Abele, inspector, country dairy inspection section, health department, City of Chicago, 54 W. Hubbard St., Chicago 10, Ill.

Mildred G. Arnold, associate editor, "Ladies' Home Journal", (Mail) 1270 Sixth Avenue, New York, N. Y.

Frank R. Bailey, director of farm service, Central Maine Power Company, 9 Green Street, Augusta, Maine.

Frank Bonnes, manager, farm tractor sales, International Harvester Co., 180 N. Michigan Ave., Chicago, Ill.

Broadus V. Brown, T/3, USA. (Mail) 131 Advent St., Spartanburg, S. C.

G. K. Chugani, assistant director of inspection, department of food, Government of India. (Mail) 42 Queen's Road, Churchgate, Bombay, India.

Robert H. Dubois, instructor in agricultural engineering, Kansas State College, Manhattan, Kans.

Gordon E. Dugal, head department and professor of agricultural engineering, Southwestern Louisiana Institute, P O Box 475, S. L. I. Station, Lafayette, La.

Milton R. Dunk, editor, Better Farming Methods Magazine, Mount Morris, Ill.

Carl E. Erickson, sales manager, electrified farm machinery, Viking Mfg. Co., 219 East Washington St., Jackson, Mich.

Lawrence I. Frisbie, tester, International Harvester Co., 180 N. Michigan Ave., Chicago, Ill.

Wilbur Higgins, Jr., sales manager, Starline, Inc., Harvard, Ill.

Henry G. Kornwolf, tractor sales representative, J. I. Case Co., Racine, Wis. (Mail) 11 Riverside Drive.

Stirling Leitch, standardization engineer, Aluminum Company of America. (Mail) 1218 Forest Ave., Maryville, Tenn.

Christian L. Martin, Major, USA. (Mail) 1116 Crest Lane, Lancaster, Pa.

E. Vincent Martinson, mechanical engineer, National Advisory Committee for Aeronautics, Cleveland Airport, Cleveland, Ohio. (Mail) 17631 Parkmount Ave.

R. E. McKnight, assistant extension agricultural engineer, Virginia Polytechnic Institute, Blacksburg, Va. (Mail) Box 452.

George O. Mullan, rural representative, Potomac Edison Co. (Mail) Hagerstown, Md.

Marvin Nabben, Y.M.C.A., Paterson, N. J.

H. S. Newlin, chief engineer in charge of design, The Hardie Mfg. Co., Hudson, Michigan. (Mail) 108 Lafayette St.

John A. Price, engineer in charge of development, The Midland Co., 1200 Rawson Ave., South Milwaukee, Wis.

William P. Oehler, chief experimental engineer, Deere & Mansur Works, Deere & Company, Moline, Ill.

Nathan H. Rich, assistant professor of agricultural engineering, University of Maine, Orono, Maine.

Clifford R. Rogers, plant manager and chief engineer, The Oliver Corp. (Mail) 1404 S. Lodge, Shelbyville, Ill.

H. Wayne Stone, agricultural power engineer, Pacific Gas and Electric Co. (Mail) 739 Harvard, Fresno 4, Calif.

Donald A. Womeldorff, farm equipment specialist and district sales manager, General Electric Supply Corp. 845 S. Clinton, Chicago, Ill.

Robert E. Wood, sales engineer, Solar Aircraft Co., Des Moines, Iowa. (Mail) 671 48th St.

TRANSFER OF GRADE

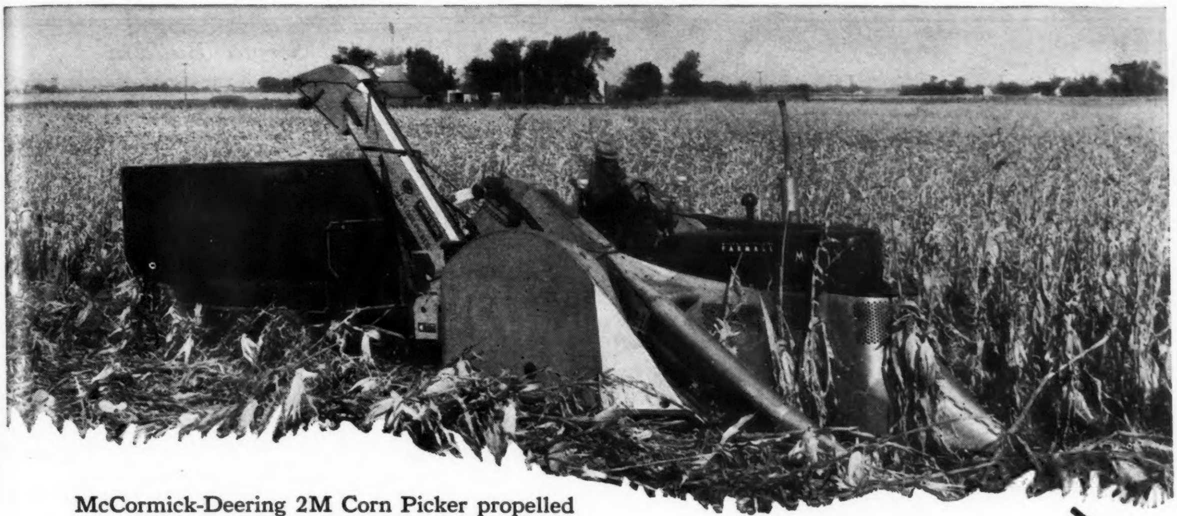
Lester G. Kopp, section head, Goodyear Aircraft Corp., Akron, Ohio. (Mail) 1184 Juniper Ave., Akron 10. (Junior Member to Member)

H. P. Smith, chief, agricultural engineering division, Texas Agricultural Experiment Station, College Station, Texas (Member to Fellow)

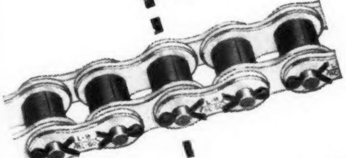
James P. Sproul, work unit conservationist, Soil Conservation Service, USDA. (Mail) Hoxie, Kansas (Junior Member to Member)

Eyvind B. Wahlgren, navigation instructor, USNR. (Mail) % Thole Wahlgren, RR No. 1, Monmouth Junction, N. J. (Junior Member to Member)

Clyde Walker, agricultural contact manager, R. M. Wade & Co., Portland, Ore. (Associate to Member)



McCormick-Deering 2M Corn Picker propelled by International Harvester "Farmall" Tractor.



Personnel Service Bulletin

The American Society of Agricultural Engineers conducts a Personnel Service at its headquarters office in St. Joseph, Michigan, as a clearing house (not a placement bureau) for putting agricultural engineers seeking employment or change of employment in touch with possible employers of their services, and vice versa. The service is rendered without charge, and information on how to use it will be furnished by the Society. This bulletin contains the active listing of "Positions Open" and "Positions Wanted" on file at the Society's office, and information on each in the form of separate mimeographed sheets, may be had on request.

POSITIONS OPEN

DESIGN ENGINEERS (12) for combines, corn pickers, hay balers and tractors. Midwest farm machinery manufacturer. Salary, $250 to $325 a month. O-401

EXTENSION SPECIALIST in farm safety and fire prevention. Midwest state college. Salary, $2400 to $3200. O-403

SALES ENGINEERS (3) to work with dealers, farmers, etc. Large distributor of specialized farm equipment in five states. Salary and commissions to net $5000 to $8000. O-409

DESIGNERS (3) for farm tractors and machines. Southern farm machinery manufacturer. Salary $3600 to $8000. O-411

LABORATORY TECHNICIAN for chemical analysis of feeds, etc. Midwest farm supply company. Salary open. O-412

ASSOCIATE AGRICULTURAL ENGINEER for sales promotion of building materials. Building materials manufacturer. Location, Middle West. Salary (middle range), $3600 to $4200. O-413

AGRICULTURAL ENGINEER (P-3) for refrigerated apple storage research in state of Washington. Federal agency. Salary, $3640. O-420

AGRICULTURAL ENGINEER (P-2) to assist in grain storage studies in southeastern states. Federal agency. Salary, $2980. O-422

AGRICULTURAL ENGINEER (P-4) to serve as project leader for grain storage studies in southeastern states. Federal agency. Salary, $4300. O-423

FIELD ENGINEER for promotional and extension work on farm buildings in the south. Lumber trade association. Salary open. O-428

EXTENSION AGRICULTURAL ENGINEER to specialize in farm buildings. Southern state college. Salary open. O-430

RURAL ELECTRIFICATION SPECIALIST for teaching and research. Southern state college. Salary open. O-434

AGRICULTURAL ENGINEER for designing and improving special machinery for muck soil operations. Midwest grower of special crops. Salary, $5000 to $10,000 plus bonus. O-436

RURAL ELECTRIC SERVICE ENGINEERS (8) for rural electrification promotion. Midwest electric utility. Salary, $2700 to $3600. O-438

AGRICULTURAL ENGINEER for teaching assistant in drainage and terracing and farm power and machinery, with opportunity to work for M.S. degree. Southern state college. Salary, $1500. O-439

CIVIL ENGINEERS III (3) for hydrological investigations in flood and low flow control and conservation. Midwest state agency. Salary, $310 to $360 per month. O-440

CIVIL ENGINEERS II (3) for hydrological investigations in flood and low flow control and conservation. Midwest state agency. Salary, $260 to $210 per month. O-441

CIVIL ENGINEERS I (2) for hydrological investigations in flood and low flow control and conservation. Midwest state agency. Salary, $210 to $260 per month. O-442

ENGINEERING AIDES II (2) for drafting work. Midwest state agency. Salary, $175 to $220 per month. O-443

ENGINEERS (3) for design and development work on garden tractors and equipment for use with them, and on horse-drawn implements. Eastern farm machinery manufacturer. Salary open. O-444

AGRICULTURAL ENGINEER for design, promotion and extension work on farm structures. Middle West building materials manufacturer. Salary, $250 to $300 per month. O-445

AGRICULTURAL ENGINEERS (5) to advise and assist power distributors in use of electricity on farms in Tennessee Valley. Federal agency. Salary, $3000. O-446

ENGINEER for laboratory testing and research on farm machinery, tractors and engines. Midwest farm machinery manufacturer. Salary open. O-447

SALES ENGINEER to contact and assist design engineers of farm machinery in design of power transmissions. New England power transmission manufacturer. Salary open. O-448

ASSISTANT EXTENSION AGRICULTURAL ENGINEER as full-time specialist in safety and farm buildings work. Eastern state college. Salary, $3000 or more. O-449

AGRICULTURAL ENGINEERS (several) for work in both design and distribution of farm equipment at several locations in Middle West. Salary to fit qualifications. O-450

AGRICULTURAL ENGINEER for research and development on machinery for applying insecticides and fungicides to farm crops. Eastern farm machinery manufacturer. Salary, $3000 to $4000. O-451

ASSISTANT OR ASSOCIATE AGRICULTURAL ENGINEER for research and teaching in irrigation, soil erosion, and land development work. Western state college. Salary, $3000 to $3600. O-452

AGRICULTURAL ENGINEER to supervise work in farm machinery development and be responsible for related research in equipment to meet needs of farmers in Tennessee Valley. Federal agency. Salary, $4300. O-453

AGRICULTURAL ENGINEER to serve as associate project leader on research and development projects relating to irrigation, water systems, frost control equipment, terracing equipment, etc., in Tennessee Valley. Federal agency. Salary, $3000. O-454

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PERSONNEL SERVICE BULLETIN

(Continued from page 482)

AGRICULTURAL ENGINEER to assist associate project leader in conducting joint research projects relating to irrigation, water systems, frost control equipment, terracing equipment, etc., in Tennessee Valley. Federal agency. Salary, $2100. O-455

IRRIGATION ENGINEER for experimental work on use of water in irrigation, etc. Midwest state college. Salary, $3400 or more. O-456

DISTRICT MANAGER to make recommendations for and sell electric fly-screen installations in central New York state. Eastern manufacturer. Salary, $3000 to start. O-458

DESIGNERS, class A (3), for design of grain, corn, hay, and silage harvesting machinery. Midwest farm machinery manufacturer. Salary, $275 per month. O-459

DESIGNERS, class B (3), for layout work on grain, hay, and silage harvesting machinery. Midwest farm machinery manufacturer. Salary, $235 per month minimum. O-460

AGRICULTURAL ENGINEER (assistant professor rank) for teaching and research work in all branches of agricultural engineering, Eastern state college. Salary, $2800 per year. O-461

AGRICULTURAL ENGINEER for drafting, design, and development work on farm machinery. Eastern farm equipment manufacturer. Salary open. O-462

EXTENSION SPECIALIST in farm structures. Midwest state college. Salary, $3000 to $3600. O-463

RESEARCH SCHOLARSHIP in connection with dairy barn research project. Midwest state college. Salary, $1400, with opportunity to carry up to 5 credits of college work. O-464

PROMOTION DIRECTOR to supervise and plan structures activities in farm and industrial fields, at Midwest location. Eastern trade association. Salary, $6000 to $7500. O-465

JUNIOR PROMOTION MAN (on farm structures) to prepare publicity, advertising, etc., and to work with colleges, 4-H clubs, etc., at Midwest location. Eastern trade association. Salary, $3500. O-466

ASSISTANT EXTENSION AGRICULTURAL ENGINEER for all branches of field. Southwest state college. Salary, $3200 to $3400. O-467

EXTENSION ENGINEER in rural electrification. Midwest state college. Salary, up to $4000. O-468

AGRICULTURAL ENGINEER to develop and design pumps and other farm implements. Western New York farm machinery manufacturer. O-469

RESEARCH FELLOWS (3) in agricultural engineering, with opportunity to carry full-time graduate study leading to master's degree. Midwest experiment station. Salary, $540 for 9 months. O-470

COPYWRITERS (2) for tractors and tractor-mounted and tractor-driven implements and machines. Midwest farm machinery manufacturer. Salary $150 to $325 per month. O-471

ENGINEERS for conservation work with U. S. Soil Conservation Service. Entrance salaries, $2320 (P-1) and $2980 (P-2). (A.S.A.E will refer interested persons to appropriate SCS regional offices on request.)

POSITIONS WANTED

ARICULTURAL ENGINEER (B.S. degree) desires research or design and development work in rural electrification or with general public utility, in either private industry or public service. Age 39. W-203

AGRICULTURAL ENGINEER desires sales and/or engineering work in Southwest P. S. *only*, on salary and commission. Ten years' farm machinery sales experience. Age 42. W-204

AGRICULTURAL ENGINEER (B.S. degree) desires sales engineering and service work in farm structures or building materials field. Age 39. W-208

AGRICULTURAL ENGINEER desires product design and development work in farm machinery industry, or college teaching of power and machinery. Age 32. W-209

MECHANICAL ENGINEER (B.M.E. degree and ag-eng. experience) desires sales engineering and service work in rural electrification field. Age 46. Salary, $4000. W-212

AGRICULTURAL ENGINEER (B.S. degrees in both ag and ag-eng.) desires teaching, extension or research work in power and machinery. Age 39. W-213

AGRICULTURAL ENGINEER (B.S. degree) desires research, sales engineering, or design and development work in farm equipment industry, Age 27. Salary, $4000 to $5000. W-216

AGRICULTURAL ENGINEER (Equivalent of M.S. degree) desires design, development or research work in farm equipment industry. Age 35. Salary, $4200 and up. W-217

AGRICULTURAL ENGINEER (B.S. degree) desires development or sales engineering and service work in farm machinery industry. Age 29. Salary, $4200 to $4800. W-218

AGRICULTURAL ENGINEER (B.S. degree) desires sales or sales engineering and service or design and development work in farm structures field. Age 35. War veteran. Salary, $5000. W-219

AGRICULTURAL ENGINEER (B.S. degree) desires sales engineering and service or research and development work in private industry in soil conservation, rural electrification, or power and machinery field. Age 25. War veteran. Salary, $2500. W-220

AGRICULTURAL ENGINEER (B. S. degree) desires development, research or sales work in power and machinery or rural electrification field. Age 24. War veteran. W-221

AGRICULTURAL ENGINEER (B.S. degree) desires design and development or sales engineering and service work in farm structures field. Age 26. War veteran. W-224

AGRICULTURAL ENGINEER (B.S. degree) desires teaching and extension or research work in rural electrification or farm structures with public service agency. Age 27. Salary, $225 to $325 per month. W-226

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"... and I'll have a long talk with my John Deere Dealer"

"Certainly, I'm going back to the farm and help dad. But before long I'll have an eighty or a quarter of my own. Modern machinery will help both of us do a better job.

"I know something about farming ... I was brought up on a farm. I know enough to realize that you've got to keep pace with what's going on. Farming is a business ... the same as anything else. There'll be new crops to grow ... new ways to make more out of your crops ... new machines to do it with.

"I'm going to find out about these things ... and I'll have a long talk with my John Deere dealer. He'll help me plan from the start ... just like he helped my dad. And he'll help *year after year* ... by providing good service and keeping me posted on new developments in farming and in farm equipment. He's going to be a real help to me."

* * *

Yes, John Deere factories and John Deere dealers will be ready to serve young America ... ready to advise them on best farming methods and equipment ... ready to serve them with quality farm equipment that fits their farm ... fits their crops ... fits their pocketbooks.

PERSONNEL SERVICE BULLETIN

(Continued from page 484)

AGRICULTURAL ENGINEER (B.S. degree in both Ag. and M.E.) desires design and development work in farm machinery field. Age 29. Salary, $350 per month minimum. W-227

AGRICULTURAL ENGINEER (B.S. degree) desires design and development or research work in farm machinery field. Age 29. Salary, $3500 to $5000. W-228

AGRICULTURAL ENGINEER (B. S. degree) desires sales engineering or service work in power and machinery, rural electrification, or soil and water field, with public service agency or private industry. Age 25. War veteran. W-229

AGRICULTURAL ENGINEER (B.S. degree) desires design and development or research work in farm structures or soil and water field, either private industry or public service. Age 35. Salary, $5000. W-230

AGRICULTURAL ENGINEER (B.S. and M.S. degrees) desires research, teaching, and/or extension work in rural electrification with public service agency or in private industry. Age 35. Salary, $4000 to $8000. W-231

AGRICULTURAL ENGINEER (B.S. degree) desires design and development work in farm machinery field. Age 26. War veteran. Salary, $2600 a year. W-232

AGRICULTURAL ENGINEER desires design, development, research, sales or sales engineering and service work in farm structures field *only*, in either private industry or public service. Age 40. Salary, $4500 minimum. W-233

AGRICULTURAL ENGINEER (B.S. degree) desires sales engineering and service work in farm machinery field. Age 30. War veteran. W-234

AGRICULTURAL ENGINEER (B.S. degree) desires design and development work in farm machinery or farm structures field in either private industry or public service. Age 30. Salary, $3600. W-235

AGRICULTURAL ENGINEER (B.S.A. and M.A. degrees, major in ag-eng) desires sales engineering and service work in farm machinery industry, or power and machinery or soil and water work with federal agency or state extension service. Age 43. War veteran. W-236

AGRICULTURAL ENGINEER (B.S. degree) desires design and development or sales engineering and service work in farm machinery field or research and development in soil and water field. Age 26. War veteran. Salary, $3200 to $3500. W-237

AGRICULTURAL ENGINEER (B.S. degree) desires time-study or service work in farm machinery industry. Age 28. Salary, $2500 to $3000. W-238

AGRICULTURAL ENGINEER (B.S.A. degree, major in ag-eng) desires college teaching or extension, or service work with private company in power and machinery field. Age 36. Salary $2600 (minimum). W-239

PROFESSIONAL DIRECTORY

AGRICULTURAL ENGINEER (B.S. degree) desires service or research work in farm machinery or rural electrification field, with private company or college. Age 31. Salary $2000 and up. W-240

AGRICULTURAL ENGINEER (B.S. degree) desires design and development work with private company or work in soil and water field with government agency. Age 28. Salary $3000 minimum. W-241

AGRICULTURAL ENGINEER (B.S. degree) desires research, design, or sales engineering work in rural electrification with private company or public agency. Age 30. Salary $3200 to $3600. W-242

AGRICULTURAL ENGINEER (B.S. degree) desires service or research work in rural electrification or farm structures field with private company or government agency. Age 28. Salary $200 per month. W-243

AGRICULTURAL ENGINEER (B.S. degree) desires soil conservation work with government agency or extension and college teaching of agricultural engineering subjects. Age 28. Salary $2400 to $3000. W-245

SALES REPRESENTATIVE, with 26 years' experience in implement and tractor fields, desires sales work with farm machinery company. Age 55. Salary open. W-246

AGRICULTURAL ENGINEER (B.S. degree) desires service, research, or extension work in farm machinery, soil and water, or rural electrification field with private company, government agency, or college. Age 26. Salary $2320. W-247

AGRICULTURAL ENGINEER (B.S. degree) desires sales engineering and service work in power and machinery with private company. Age 30. Salary $200 to $250 per month. W-248

AGRICULTURAL ENGINEER (B.S.A. and B.S. C.E. degrees) desires design, construction, service, research or sales work in farm structures field with private company, government agency, or state college. Age 31. Salary $4200 to $4800. W-249

AGRICULTURAL GRADUATE (B.S.A. degree, major in ag eng and minor in physics) desires research, teaching, or extension work in rural electrification, farm structures, or soil and water field with state college. Age 44. Salary $2900 minimum for 9 months. W-250

AGRICULTURAL ENGINEER (B.S. degree in agriculture and ag eng) desires work in farm buiildings or rural electrification field with public service agency or private company. Age 27. Salary $3000 minimum. W-251

AGRICULTURAL ENGINEER (B.S. degree) desires research, service or extension work in farm machinery, rural electrification, or soil and water field with private company, government agency, or college. Age 26. Salary open. W-252

AGRICULTURAL ENGINEER (B.S. and M.S. degrees in ag engineering) desires teaching and research (or extension) work in farm structures or power and machinery field with land-grant college. Age 36. Salary $3600. W-253

LANDSCAPE ENGINEER, with several years experience with state highway department, REA cooperative on construction, and construction in soil and water field, desires sales or sales promotion work in farm structures or power and machinery field. Age 35. Salary open. W-254

AGRICULTURAL ENGINEER (B.S. and M.A. degrees in agriculture and B.S. in ag engineering) desires research or research and development work with government agency or private company or teaching and research with land-grant college. Age 32. Salary $4500 to $6000. W-255

AGRICULTURAL ENGINEER (B.S. degree) desires employment in farmpower and machinery field. Age 31. Salary $3000. W-256

AGRICULTURAL ENGINEER (B.S. degree) desires work in research, design or development in power and machinery or soil and water field. Age 28. Salary $2500. W-257

AGRICULTURAL ENGINEER (B.S. degree) desires sales, sales engineering, or development work with private company in power and machinery or farm structures field. Age 31. Salary $3600 minimum. W-258

AGRICULTURAL ENGINEER (B.S. degree) desires design and development work with private company in farm machinery field. Age 30. Salary $325 to $350 per month. W-259